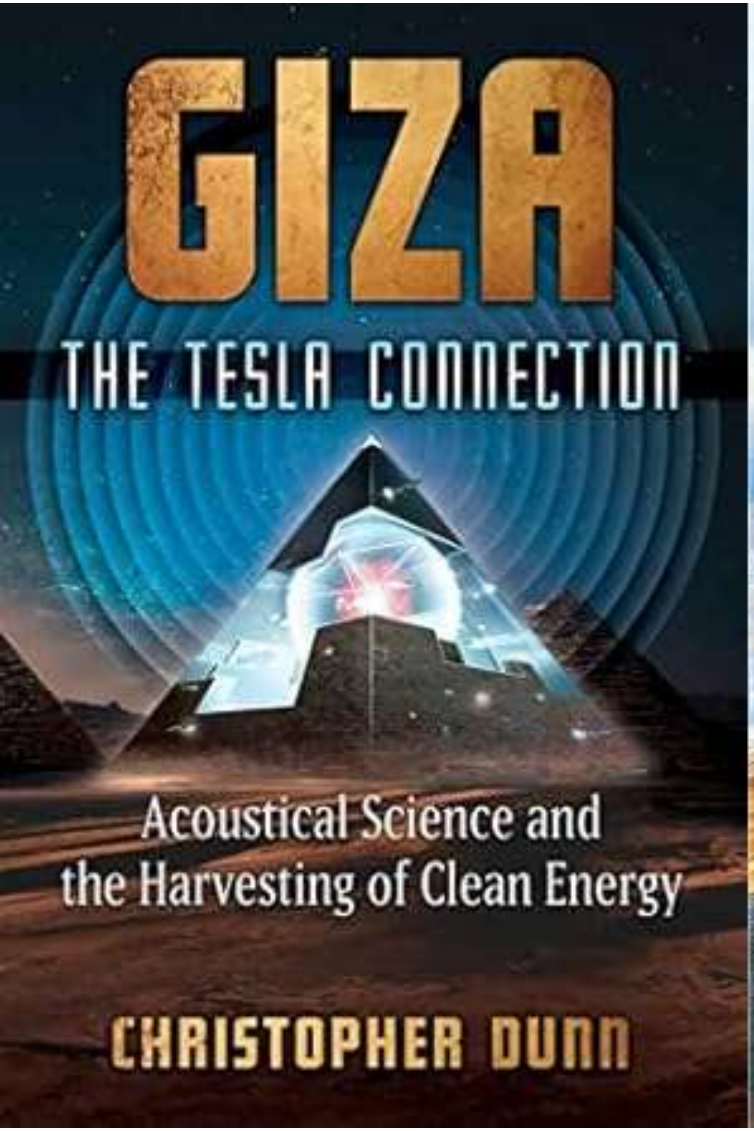
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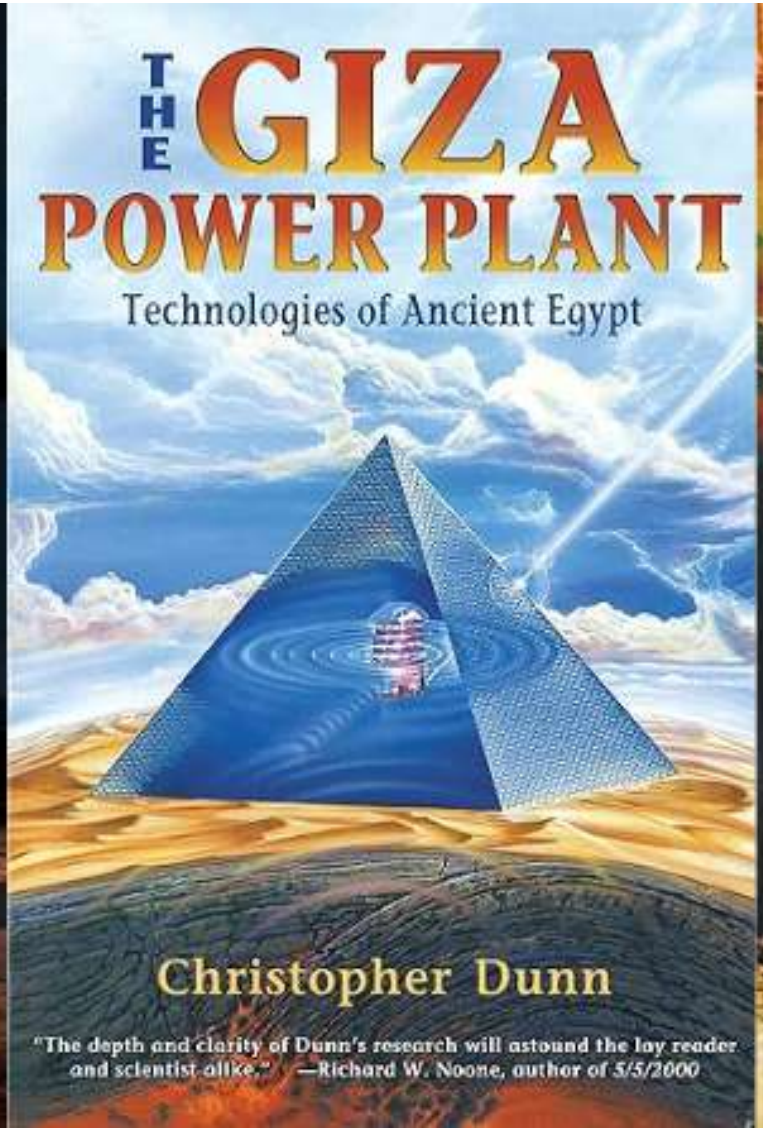
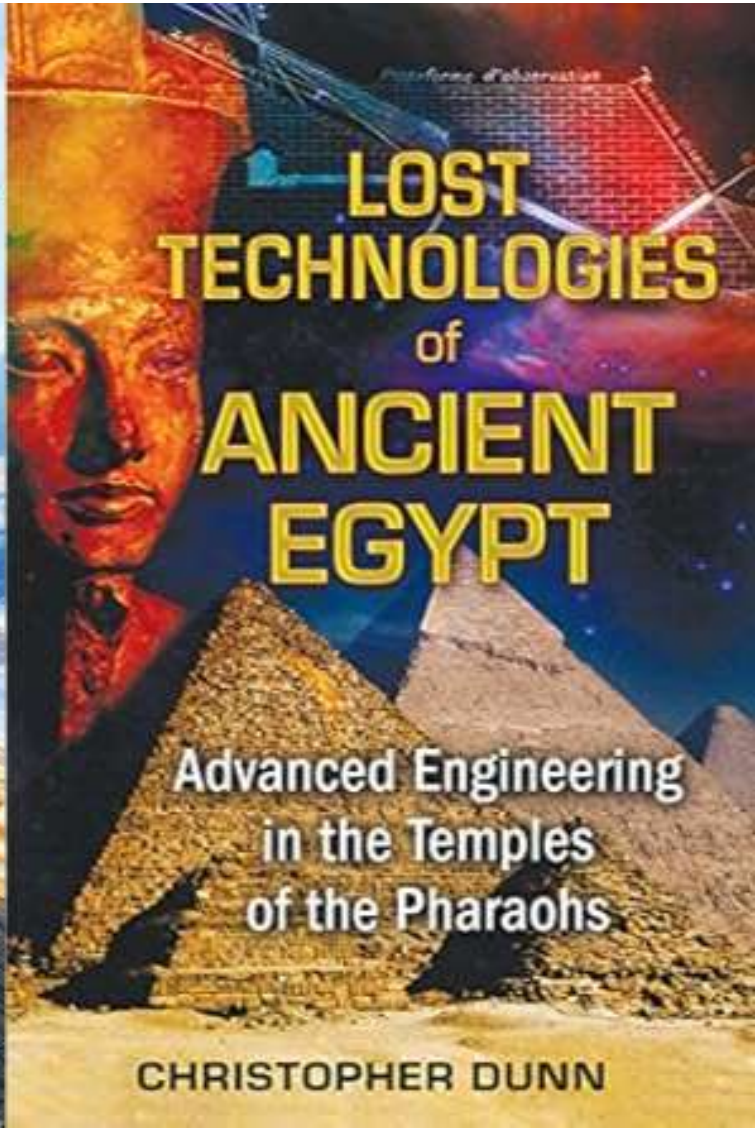
the Harvesting of Clean Energy
CHRISTOPHER DUNN


THE GIZA
POWER PLANT
Technologies of Ancient Egypt
Christopher Dunn
"The depth and clarity of Dunn's research will astound the lay reader and scientist alike." —Richard W. Noone, author of 5/5/2000


LOST
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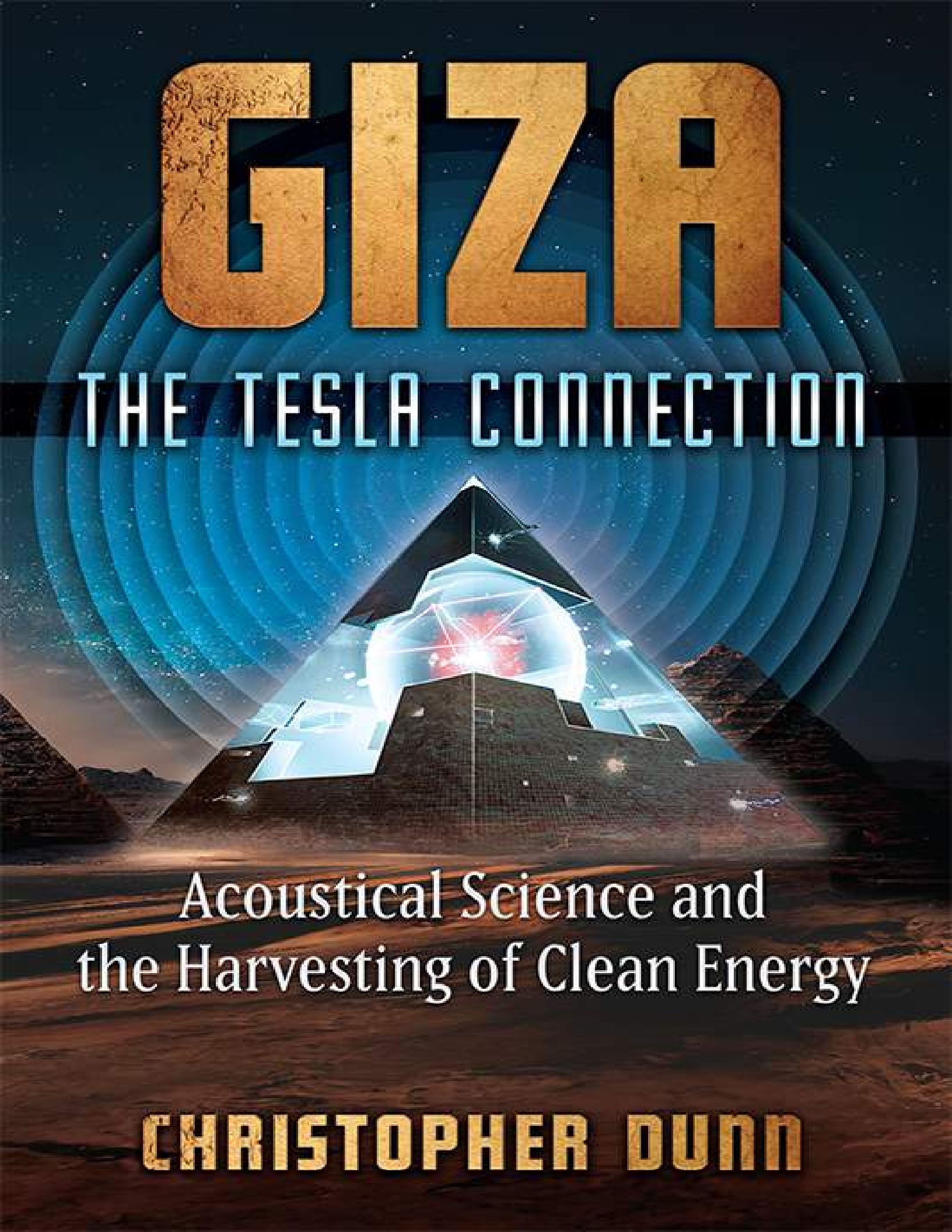
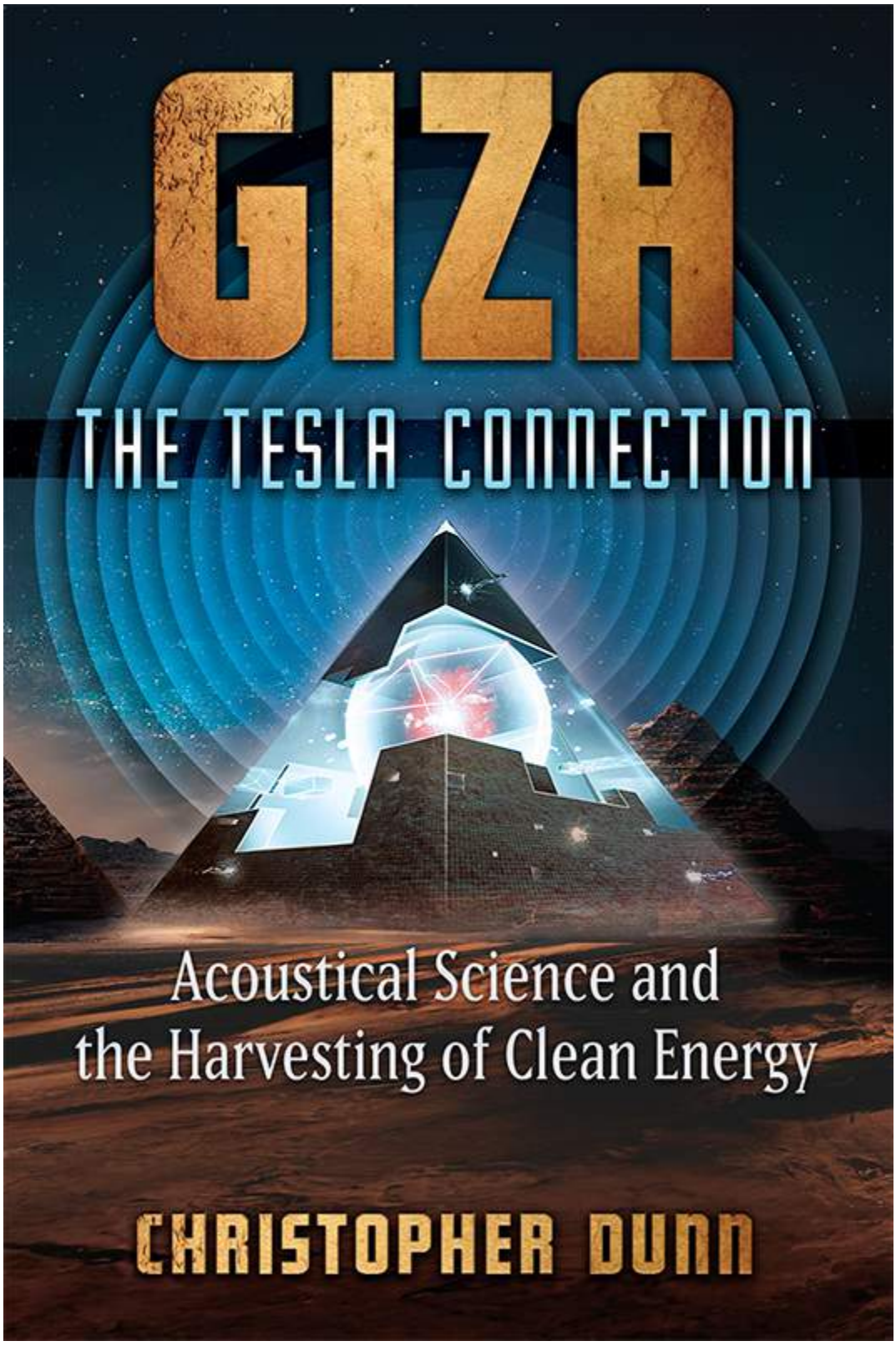


Acoustical Science and the Harvesting of Clean Energy

CHRISTOPHER DUNN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GIZA
THE TESLA CONNECTION

"Is the Great Pyramid of Giza just a 'tomb and tomb only,' or is there much more to the last surviving wonder of the ancient world than the limited minds working within the cult of Egyptology are capable of grasping? There have been many theories but Chris Dunn's latest book, *Giza: The Tesla Connection*, is by far the most important, detailed, and convincing case ever made for a lost advanced technology of prehistory that left its mark on the sublime works of the ancient Egyptians."

GRAHAM HANCOCK, AUTHOR OF *FINGERPRINTS OF THE GODS, MAGICIANS OF THE GODS,* AND *AMERICA BEFORE*

"This is masterful work. *Giza: The Tesla Connection* provides a comprehensive, engineering-focused hypothesis for one of the world's greatest mysteries. Accounting for the myriad of recent new discoveries surrounding the Great Pyramid, Dunn ties these together with disparate scientific advances into a cohesive and comprehensive explanation for its purpose and function, resulting in mind-bending conclusions and staggering implications for our understanding of the history of civilizations on planet Earth. Dunn playfully entertains speculation and takes the reader on a journey of technological wonder into the unknown past and future with appropriate context and an open-minded approach, something sadly lacking from modern-day academic Egyptology. As the inevitable progression of our scientific understanding of ancient technology slowly forces a reimagining of our own past, Dunn's body of work will be recognized for the groundbreaking strides it truly represents in unraveling the mysteries of the ancient Egyptian's, and our, ancestors. Like the work of his engineering-focused predecessor Sir Flinders Petrie, this book is required reading for anyone wishing to delve into these fascinating topics."

BEN VAN KERKWYK, AUTHOR AND CONTENT CREATOR AT UNCHARTEDX.COM

“Dunn’s shocking and cutting-edge research on nonpolluting free energy is forcing Egyptologists to think the unthinkable—that the technology on the Giza Plateau was more advanced than our current science. Bravo, Chris! A must-read for deep ecologists and readers seeking the real story of the past. At last! We have the answer to the riddle of the Great Pyramid.”

BARBARA HAND CLOW, AUTHOR OF
AWAKENING THE PLANETARY MIND
AND *REVELATIONS FROM THE SOURCE*

GIZA

THE TESLA CONNECTION

Acoustical Science and the Harvesting of Clean Energy

CHRISTOPHER DUNN

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To my wife, Jeanne Simpson Dunn.
Without her love, patience, protection, and guidance,
this book would not exist.

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FOREWORD

AN EGYPTIAN ENGINEER'S POINT OF VIEW

AHMED ADLY

Growing up in Egypt, I studied at school all the traditional theories about the "Pyramid Tomb" having been built with primitive tools and visited them a couple of times, all the while not focusing much attention on the science and knowledge behind these enigmatic treasures; this is a short story of Egyptians of my age. Time passed, and I worked as an electrical and systems engineer in a global telecom company in Giza. For years, I kept passing by the pyramids on my way to the office, looking at them and asking if all that effort was worth only hosting the king's body after his death?

Later in my life, I had the chance to read Chris Dunn's two books, *The Giza Power Plant* and *Lost Technologies of Ancient Egypt;* after this moment, things that had not made sense to me before began to make sense. The ideas proposed in his books are logical and striking at the same time. Despite many questions being answered, more questions were raised. It was a turning point for me, and I have begun to look at the monuments differently.

I decided to challenge some of Dunn's ideas on a deeper level, such as the Serapeum boxes' precision. In October 2019, I brought two digital measuring devices, a laser distance measure from Bosch, with an accuracy of $^{1}/_{16}$ inch (1.5 mm) for 165 feet (50 m) and a digital protractor with an accuracy of +/− 0.3 degrees to measure the inside corners. *Digital instruments far surpass the precision of the measuring instruments used by*

the ancient Egyptians, I told myself while standing in front of one of the giant boxes I had randomly chosen. Applying the instruments, I was astonished to find that the internal measurements are so precise, with unique characteristics of parallelism and right-angled corners of 90.0 degrees (not 90.1 and not 89.9). Measuring the width and length of the inside of the box from four corners, the lengths were both 3.091 meters (10.141 feet) and the widths were 1.495 meters (4.904 feet). In addition, when identifying what craft skills would be needed to produce artifacts with such precision during the modern era of industrial development, they would be skilled machinists and die makers. Not quarry workers, carpenters, or sculptors.

I came out of the underground tunnels telling myself, *It seems that Chris Dunn was right! Advanced methods must have been used to make these boxes.* While I had the permit to measure just one box, I later learned from other friends and colleagues who applied different measures inside the corners of other boxes, that some are 90° and others are found to be less than perfect conditions, though not varying enough to ignore the significance of the artifacts. Additional analysis and unified measures are required to understand these boxes. However, in my opinion, applying only primitive methods to carve and transport these boxes is highly doubtful and still unverified.

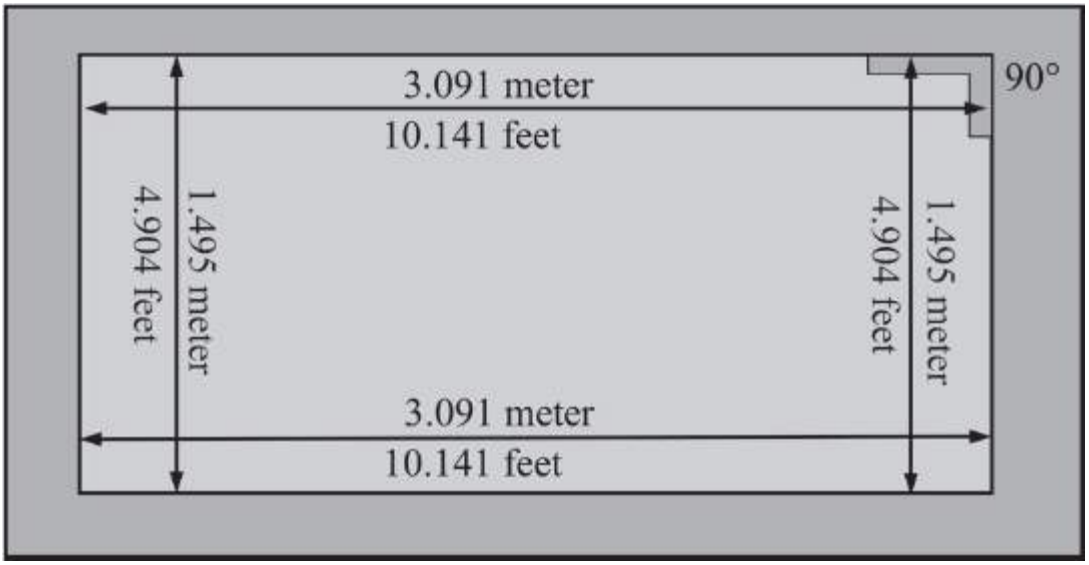

Figure F.1. Adly's measurements of a Serapeum granite box.
Image credit: Ahmed Adly.

Not only are modern visitors startled by the boxes' sizes but so was August Mariette, who in *Le Sérapéum de Memphis* wrote, "The dimensions of the granite sarcophagi found in the large undergrounds are well made to amaze the visitor. This leads me to record here a note on an interesting question of ancient mechanics, how the Egyptians could have introduced such masses into the depths of an underground passage and into chambers from which it would certainly be very difficult to draw them, even with the help of the most ingenious complications of modern mechanics" (Mariette 1882).

By the date of the discovery of the Serapeum in 1851, the machine era had already started a while ago; there were already locomotives, lifters, hydraulic presses, moving machinery, steam engines, and more. I guess that Mariette wasn't far in his assumption; however, he didn't find any kind of machinery in the tunnels except wooden winches, so he established the transport method of the boxes based on what he had found.

I filmed the measurement operation and published it in a video in Arabic (Adly 2021). I also applied different measures for several other artifacts, like obelisks, statues, and pillars. Sharing these observations in the form of magazine articles and videos gradually grabbed Egyptian and Arabic speakers' attention to the fact that we have missed a vital piece of ancient Egyptian history.

For a long time, the pyramids were a mystery, and they still are. There are always three areas of debate when discussing the pyramid tomb theory with professional Egyptologists, especially when talking about the Fourth Dynasty giant pyramids in Giza and Dahshur. Unambiguously, we are assured that they are tombs. But why are there no original mummies? Why the lack of inscriptions? Why does their interior architecture look nothing like ordinary tomb design, which is apparent in the ancient tombs in the Valley of the Kings in Luxor and other sites? Why are these things missing from the Fourth Dynasty pyramids?

Mainstream academics still claim that the reason for not finding any original mummies buried in pyramids is because they were robbed in antiquity. While this is a commonly held view, valid arguments can be made against it. In the early 1900s, Italian archaeologist Alessandro Barsanti explored the great pit of the Zawyet el Aryan pyramid. Under 65 feet (20 m) of large blocks, he found a sealed giant granite sarcophagus. On removing the lid they found it was empty, except for the black material that

lined the side walls. Barsanti was confused as to why one would have taken the care of concealing the sarcophagus under an enormous mass of blocks if it had been empty (Barsanti 1906). This was not the only such case. Around 50 years later, in 1954, Egyptologist Mohammed Zakaria Ghoneim excavated the unfinished pyramid of Sekhemkhet (a Third Dynasty king) in Saqqara (Ghoneim 1956). The burial chamber lies at 236 feet (72 m) from the entrance, and an alabaster sarcophagus stands in the middle of the room with a vertically sliding door at one end. The door was shut and plastered, and hopes were raised to a high pitch. Shockingly, when the sarcophagus was opened, it was also empty and unused. A question arose from the Egyptologists themselves without any clear answer, "Had any king ever been buried here?"

These two cases disprove the argument that "pyramids were tombs, but the evidence to prove it was removed by tomb robbers," and support the contention that pyramids were not built to be used as royal tombs. However, the absence of necessary evidence is ignored by academics. The only mummy attributed to a pyramid owner has been discovered inside the black basalt sarcophagus in the pyramid of Merenre (a Sixth Dynasty king). This mummy is today in the Imhotep Museum at Saqqara. Nonetheless, there are strong doubts about its identification. The great anatomist of the Egyptian mummies, Grafton Elliot Smith, studied and considered it to be of a much later period, possibly the Eighteenth Dynasty. If the pyramids were tombs, they should be viewed as the biggest failures in history, because they have never protected their owners' bodies.

The lack of hieroglyphs in the Fourth Dynasty pyramids is still a weak spot of the pyramid tomb theory, especially if we recognize that Khufu's children, Nefertiabet, Khufukhaf I, Meresankh II, and Meresankh III, have well-written and colorful inscriptions in their tombs at the Giza Plateau. If so, why was inscribing the nine neighboring pyramids of Giza skipped (Fakhry 1969; Lehner 1997)?

The interior design of the pyramids is another serious argument. In a discussion with Hazem Zaki, a ministry of tourism and antiquities inspector on the Giza Plateau, I was wondering how King Sneferu would have been buried in his red pyramid at Dahshur. The pyramid's entrance passage is too narrow even for a single person; it is 3 feet (0.91 m) in height and 4 feet (1.2 m) wide and slopes down at 27 degrees for 200 feet (61 m). Putting the king's body alone on a sled is the only possible scenario, although not

appropriate for his majesty. Zaki respectfully agreed that the burial procedure would be a nightmare and that we don't know how such funeral ceremonies could take place inside giant pyramids.

The true purpose for why the pyramids were built is what matters. This point could solve many mysteries. Everything should have reasoning for why it exists or is done. Ancient Egyptians cut and moved millions of stones, some of them from quarries that are hundreds of miles away, in a long and regular process for a purpose that would serve hundreds or thousands, not just a single person.

For millennia, explorers and historians were overwhelmed by the size and perfection of the pyramids of Giza. Still, one question mystified every visitor: Why did the architects decide to build the three pyramids of Giza with large stones? The average weight of a stone block in the core masonry of the Great Pyramid is 2.6 tons, and some weigh up to 15 tons. In the second pyramid, it is even more; we have estimated as much as 60 tons in the base. Why did they do so? Unless they wanted to create trouble for themselves and make the project impossible, the architects knew well that using small stones would have been easier and faster in raising the superstructure. Yet they may cause the pyramid function to fail! Could the giant interlocking rocks be there to withstand the underground vibrations proposed by Dunn?

It is not an exaggeration to say the pyramid machine theory marks a paradigm shift, not just for technical professionals but also for Egyptologists. During my discussions with many Egyptologists and tour guides, I was told that they are convinced by many documentaries and writings (based on Dunn's hypothesis) that the pyramids are not royal tombs. Still, unfortunately, for many reasons they cannot say that in public.

In *The Giza Power Plant*, an engineer looks at the Great Pyramid and sees something different. Dunn highlights and solves many ancient puzzles hardcoded among the rocks centuries ago. He proposes that the Great Pyramid of Giza was a power plant of ancient Egypt and investigates each of its unique features while providing a convincing and scientific explanation. He opened the door for many to look differently at our distant past. If our modern civilization relies on energy, why should we not assume the same for the ancients? Instead of burning fuel, though, they depended on the power generated from an exceptional understanding of the physical properties of the rocks. What everyone I have talked to admires about

Dunn's research is that he not only tells you the direct conclusion but also shows the steps he followed, the analysis he did, and the observations he made to achieve a particular result.

Inspired by the pyramid machine ideas, many Egyptian engineers, chemists, and scholars believe that the effort behind building these massive structures was a rational one where every component was critical to its successful function.

In June 2021, after I had published a one-hour video on my YouTube channel explaining the end-to-end idea of the pyramid machine based on *The Giza Power Plant* book with the pump version from John Cadman, I received an email and later a phone call from A. M. El Sherbini, PhD, professor of experimental laser-plasma physics at the Faculty of Science, Cairo University, showing interest in the idea and a kind invitation to share his thoughts about it.

Professor Sherbini is a physicist who has made a global contribution to physics, has a method registered in his name for laser spectroscopic analysis of materials, and is a specialist in hydrogen-alpha. Fortunately, he is not far from Egyptian antiquities. In 2015, he gave a lecture in the Egyptian Museum in Cairo entitled "Recent Application of Laser in Archaeology," helping archaeologists use technology in their day-to-day discoveries.

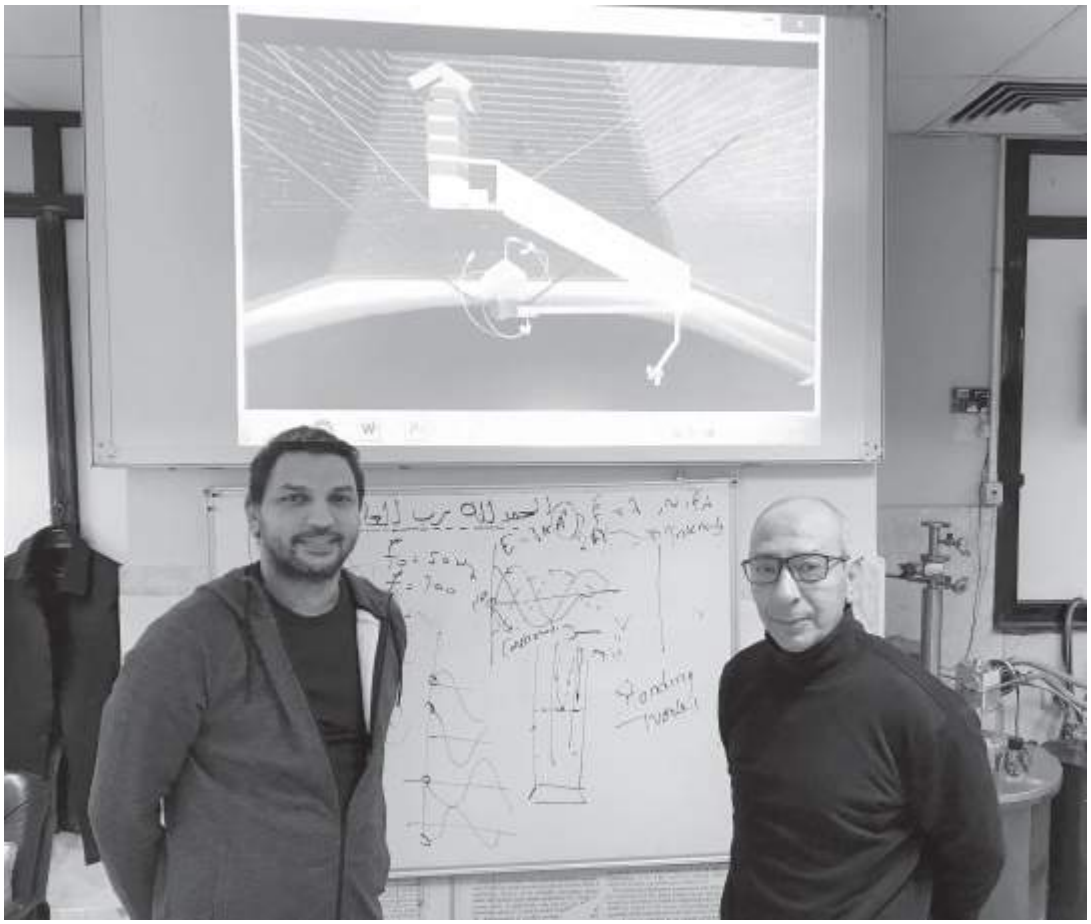

Figure F.2. Professor Ashraf El Sherbini (right) and engineer Ahmed Adly (left) in Sherbini's laboratory at Cairo University.
Image credit: Ahmed Adly.

In December 2021, I met with Sherbini in his laboratory at Cairo University to discuss several points around ancient Egypt and the tools used to build the remarkable monuments. The idea of *The Giza Power Plant* was one of the topics on our agenda, with its evidence, strengths, and weaknesses, and how to solve the outstanding points with more measurements and analysis. Although Sherbini is a challenging physicist, he supports the power plant hypothesis. These are some of his words and notes:

- The idea of the pyramid machine is brilliant and very reasonable. It is impossible that the Egyptian builders made such a considerable effort for just tombs. The interior design, including shafts and chambers, looks like a machine and does not fit the tomb theory.

- The subterranean chamber pump that generates pulses, the Queen's Chamber chemical reactions to produce hydrogen, and then the resonating King's Chamber is a logical sequence and provides answers to the design.
- The mysteries of the pyramids, how they were built, and their function are too difficult to be solved solely by Egyptologists. The involvement of experts and specialists in physics, chemistry, engineering, geology, and other branches of science, and an organization's support, are required to bring this idea to an actual model.

Scientific criticism is essential to improve. Sherbini and I believe that investigation is required in some areas that were discussed with Dunn. For example, more quantitative acoustic experiments are needed in the King's Chamber to get a better understanding of its vibration properties, and more scientific proofs are needed for generating electromagnetic energy from the granite slabs. You will find further explanations for these points as well as more pieces of evidence about the power plant theory in this book, for which I'm glad to have been asked to provide this foreword.

Day after day, we have found that the Great Pyramid is far more mysterious than we have imagined and more of its secrets are revealed using modern technology. Since *The Giza Power Plan*t was published in 1998, several missions have been launched. The Djedi Project team sent a robotic tunnel explorer into the shafts of the Queen's Chamber using a pinhole camera to explore what is behind the stone block at its end and capture photos of what might be hidden. While ScanPyramids missions succeeded in detecting a big void of around 100 feet to 130 feet (30 m to 40 m) just above the Grand Gallery, and another corridor 30 feet (9 m) long has been discovered close to the main entrance of the great pyramid, these discoveries raise the question among people, television shows, and articles, about what could be the main pyramid function. I am happy to see that we now realize the "New Paradigm" period that Dunn discussed twenty-five years ago in his first book.

AHMED ADLY was born in Kuwait and grew up in Egypt. In August 2006, he graduated from Ain Shams University with a BCS degree in Electrical and

Systems Engineering. He is currently employed by Accenture in Düsseldorf, Germany. In 2016, Adly took up the challenge put forward in *Lost Technologies of Ancient Egypt* for Egyptian engineers to begin examining their own artifacts, and he began to examine, measure, and discuss with his peers the subject of lost technologies and share his observations to a wide, interested audience across Arabic-speaking nations through his YouTube channel, titled Ahmed Adly.

ACKNOWLEDGMENTS

I feel privileged and honored to have this opportunity to shine a light on the wonderful people who have contributed to my being able to write this book. Above all, I must express my love and respect to my parents, Peter and Celia McHugh-Dunn, who brought me into this world and who nurtured and guided me in a way that resulted in me flying away to follow a path none of us could have imagined at the time. My love and gratitude also go to my brother, Bernard (Winifred) Dunn, and sisters, Celia (Bahgat) El Nadi, Pauline Dunn, and Angela (Michael) Anderson.

My children have also been a source of inspiration. As any parent knows, what we do is mostly for our kids in the hope that we can not only provide for them when we are alive but leave something of value that they can use long into the future. Peter, Alexander, and Geno—thank you for being in my life and for your loving support.

As *The Giza Power Plant* started to take shape over 20 years before it was published in 1998, this sequel has been in the making for over 20 years since. In that book I acknowledged the many people who had provided critical information, help, and advice through the years of its development. While some appear below among those whose contribution is specific to this sequel, I thank them all again.

This book would not exist without the valuable technical knowledge and input provided by Arlan Andrews, ScD, Robert Vawter, Eric Wilson, and Friedemann Freund, PhD. With sadness and condolences to his wife, Helen, I must also report that on September 17, 2023, my dear friend and research associate Robert Vawter unexpectedly passed away. As you will read in the book, Robert was responsible for contributing a significant amount of valuable information to this work, including an appendix on

pyramid acoustics and bringing to my attention physicist Friedemann Freund's research into earthquake lights.

I am also particularly grateful for the editorial feedback I have received from Judd Peck, JD, Robert Vawter, and Greg Brown. Also, my good friend Gary Lickfett, now passed on, who reviewed the manuscript while in hospice and provided his own unique observations and suggestions. For the part they have played in its development, my thanks also go to the Board of Directors and employees at Danville Metal Stamping, Ahmed Adly, Adrian Lungan, Susan Alexjander, Dustin Carr, PhD, Hamada Anwar, JD, Hany Helal, PhD, Taha Rabeh, PhD, Galal Hassaan, PhD, Mohamed Ibrahim, Lauren Kurth, John and Robert Barta of Barta's Precision Granite, Jeff Summers, Ben Van Kerkwyk, Next Anyextee, Sohaila Hussein, Ihab Rashad, Colin Higgins, Craig Docherty, Gamal Elfouly, Matt Sibson, Andy Leskowitz, Toan Trinh, Mike Mahar, John Cadman, Mike Cadman, Ralph Ellis, Mark Foster, Gardner Peck, and Tom Neal.

Having longtime supporters who regularly provide positive enforcement is critical for any person, regardless of their pursuits. For their unfailing support and encouragement for many years, I would like to thank Graham and Santha Hancock, Yousef Awyan, Shahrzad Awyan, Paul and Ardith Keller, Chris Keller, John Heckler, Jim Cox, Carol Radford, Carol Nichols, Steve Garcia, Dr. Michael Fuesting, Carmen Miller, Elena Lewis and Cassie Lewis-Babbs, Mark and Sonnia Schroeder, Phil Langley, Tim Welch, Jason Rome, Doug Keenan, Marcus Allen, Duncan Roads, Doug Kenyon, David and Jennifer Childress, Brenda Bush, Peter Brooks, Cliff Dunning, and David Wesner.

I began writing this book in June 2021 with a deadline of March 2022. After contracting COVID in September of that year, progress came to a halt and the residual effects I suffered from the virus limited my productivity. For their patience and understanding during slipped deadlines, I would like to thank Inner Traditions and Bear & Company, a publisher that has kept my previous books in print for over 25 years, for allowing me more time to deliver the final manuscript. Special thanks go to Barbara Hand Clow, Jon Graham, Kelly Bowen, John Hays, Jeanie Levitan, Courtney B. Jenkins, Manzanita Carpenter, Ashley Kolesnik, Albo Sudekum, Debbie Glogover, Lesley Allen, and all others who have devoted time and talent to bring this book to market. I appreciate you more than you know.

Finally, I would like to acknowledge anyone and everyone who has made an effort to explain the innumerable mysteries of our past. Regardless of how they have expressed what their minds have conceived, they have added to an important conversation that, I am sure, will continue to be discussed far into the future.

INTRODUCTION

The Giza Power Plant introduced a revolutionary idea and process for creating electricity, while redefining the original purpose of the pyramids of Egypt. This expansion of the technology discussed in *The Giza Power Plant* redefines the term used for energy production and moves away from the term "power plant." Generally, this term evokes visions of heavy industrial activity with the burning of fossil fuels or splitting atoms to create steam, which pushes turbine blades that are attached to electric generators, feeding their output into the electric grid. *Giza: The Telsa Connection* describes the Great Pyramid as a solid state (no moving parts) Electron Harvester. It is designed to shake electrons loose from igneous rock in the Earth, collect them, focus them, and radiate them out into the atmosphere in vast quantities. Perhaps instead of smoke stacks dotting the landscape 100 years into the future, we will see brightly glowing pyramids in the distance—*that is if they are not covered by a dome.*

THE TESLA CONNECTION

Nikola Tesla was born in 1856 and died in 1943. In the course of his career, he was awarded 308 patents, with 112 of them being awarded in the United States alone. In 1884, he emigrated to the US and worked for Thomas Edison for a period of time, but left to eventually compete with him, and have his invention of alternating current (AC) based power generation and distribution systems accepted over Edison's direct current (DC) based power generation and distribution systems. After prevailing in this acrimonious tussle, Tesla sold his AC related patents to George Westinghouse, who was awarded the contract to build generators and transmission equipment for the Niagra Falls Power Company.

Prior to emigrating to the US, Tesla worked for the Continental Edison Company in Paris. In 1883, Tesla was working on assignment in Strasbourg, when, on his own time and expense, he constructed his first induction motor.

When I started to write this book, Tesla's work was not the most prominent subject on my mind. It was only after all the elements of the electron harvester system were put together that it became clear that as he himself had intimated, what he had accomplished in his lifetime had been inspired by a Universal core of knowledge.

> *My brain is only a receiver, in the Universe there is a core from which we obtain knowledge, strength and inspiration. I have not penetrated into the secrets of this core, but I know that it exists. (Tesla 1856–1943, 13)*
>
> NIKOLA TESLA

I would like to suggest that this same core of knowledge, strength, and inspiration did not weaken over the millennia, and also inspired the designers and builders of the Great Pyramid.

Clues to what the Tesla Connection is can be found in the artwork on color plate 6. Specifically, the inclusion of the dome. This is not there for show, or the result of whimsical artistic license, but a natural evolution of an idea that evolved from the results of NASA geophysicist Friedemann Freund's research into earthquake lights, and Tesla himself when he was experimenting with the wireless transmission of energy from his famous Wardenclyffe Tower installation.

But that is not all. *Giza: The Telsa Connection* identifies Tesla's thumbprint on the blueprint of the Great Pyramid in both the deepest and dankest location in the Great Pyramid—the Subterranean Chamber—and the tip of the pyramidion on the top. As you will learn, both areas identify a critical piece of information that every inventor who wishes to secure a patent must discover before the patent officer receives the application—that is, "prior art." An invention seeking patent protection that relies on previously patented inventions in order to work must disclose all prior art that existed.

This presents an interesting conundrum. If I applied for a patent for the Pyramid Electron Harvester, could I argue in good conscience that the

application was not relying on prior art, or inventions that existed previously? I don't think so. Without the Great Pyramid, there is no way I could have formulated the theory you will read in this book or have read in my previous books. My policy has always been one of openness. It is normal to seek patent protection for an original idea if you wish to be recognized and compensated for the idea. This is different. *Giza: The Telsa Connection* describes a means of farming electrons from the Earth, and I strongly believe, and the evidence proves, that the idea is not originally mine. It originated thousands of years ago in Egypt. Rather than exploring the legality of making a claim, I decided to write a book. Obviously, I could not produce a working model when I was in the early stages of reverse engineering and needed to attract more knowledge, intellect, and talent to add to the discussion.

While it is strongly suggested that the pyramid builders and Tesla were drawing from the same source of knowledge, does this mean that Tesla was inspired in his endeavors by studying the Great Pyramid, or did his endeavors lead him to see a connection? If he was, he didn't talk about or write about it. However, had Tesla been born in our era, when serious questions about the validity of the pyramids being tombs for the pharaohs proliferate openly in society, I have no doubt that he could have drawn more inspiration from the Great Pyramid. Would Tesla even have imagined that his genius would eventually be resurrected from his tomb to help sweep away centuries of misunderstanding about a different "tomb"? As I look forward, the Tesla connection becomes increasingly more prominent in its relationship to the Great Pyramid's intent, design, and function.

QUESTIONS

Judge a man by his questions rather than his answers.

VOLTAIRE

We cannot expect to come up with the right answers if we don't ask the right questions. In 1971, a significant groundbreaking book was published by Harper & Row, New York. In *Secrets of the Great Pyramid* the author, Peter Tompkins, began his Introduction by posing this profound and inspiring question:

> Does the Great Pyramid of Cheops enshrine a lost science? Was this last remaining of the Seven Wonders of the World, often described as the most sublime landmark in history, designed by mysterious architects who had a deeper knowledge of the secrets of this universe than those who followed them? (Tompkins 1971, xiii)

Even asking the wrong question can sometimes yield benefits, if not ultimate truth. I have found during my lifetime that more knowledge can be gained from questions that are asked than answers that are given. The way Tompkins framed his question says a lot. It makes you sit back and think, "Wait a minute. The Great Pyramid, Cheops's tomb, contains a lost science? Why ask this question?" The question implies that the author has evidence to consider an affirmative answer. Moreover, the second part of his question suggests that not only was the science available to the pyramid builders lost since they built the structure, but it has remained lost for millennia since. Furthermore, the science is not specific to just the pyramids, but extends beyond the planet.

The right question can change your life. In just one paragraph of carefully chosen words, from the day in September 1977 when I opened his book, Tompkins had framed and influenced my life going forward. By the time I had closed *Secrets of the Great Pyramid*, I had become convinced that the answer to his questions was a resounding yes! For the next 21 years, my response to his question was carried forward with conviction, leading to the 1998 publication of my book, *The Giza Power Plant: Technologies of Ancient Egypt,* and my conviction has only become stronger since. The "lost science" enshrined in the Great Pyramid, as it turns out, is far greater than I had imagined and described in my 1998 book. While the book was considered revolutionary and controversial then, discoveries made since, in different fields of research, provide corrections for some areas and amplification for others. While answers to many questions remain, the book you now hold in your hand represents the many twists and turns, along with fortuitous chance events, that bring us closer yet to providing more accurate answers to Tompkins's questions.

The Giza Power Plant has received much support over the years from readers of various backgrounds. There has also been significant criticism. Some of it blunt and harsh, and some more measured and objective. One of the most reasonable and entertaining skeptical comments regarding my

work came from a Professor of History at the University of Wales, Aberystwyth.

In his book, *Shadow Pasts: History's Mysteries*, after introducing the concept of the Great Pyramid being a coupled oscillator, along with a brief description of its various parts, William D. Rubinstein writes: "To most readers, all this will surely sound as if it comes straight from the heart of Fruitcake Land" (Rubinstein 2007, 162). Perhaps Rubinstein had heard that when I was young my father taught me how to make fruitcakes to accompany the Sunday roast, and my growing skill at doing so had been deeply embedded in my DNA—thereby influencing my life going forward.

It is an aspect of human nature to place a pejorative label on an idea that is unusual and unfamiliar. However, the reality is that new ideas and a fertile imagination have fueled the development of technology and invention—even from times when these preposterous and futuristic ideas were imagined, and laughed at, and while there were no precedents and no developed infrastructure to create them. Many of the technologies we enjoy today were previously conceived in a very special "Fruitcake Land" that was populated by science fiction writers. From this happy place we learned about flights to the moon, Space Odysseys, handheld communication devices that let you see who you are talking to, and many other flights of fancy and wild imaginings. Famous science fiction writer Arthur C. Clarke, who with Stanley Kubrick cowrote the screenplay for the 1968 movie *2001: A Space Odyssey,* wrote what became known as "Clarke's Third Law:"

> *Any sufficiently advanced technology is indistinguishable from magic.*
>
> ARTHUR C. CLARKE

If we look at the technology that existed 100 years ago and how it was used, it is foreign and strange looking to most young people. Someone in their later years, like myself, who remembers what it was like to lower an arm with a sharp needle mounted in the end, into a tiny spiral groove cut into the surface of a vinyl disc, may sink into the mists of nostalgia until they are suddenly jolted into the twenty-first century by a tingly vibration in their pocket. Retrieving a black rectangular device, they swipe or press a region of the black screen and voice their usual greeting. They are now holding in their hands a small miracle of modern technology, in which they can store

the music from every vinyl long-playing record they ever owned—and so much more. Sixty years ago, as they cleaned and buffed a vinyl disc before placing the center hole on a rod to lower it onto a platen, could they even have imagined a world in which they can access entertainment the way we do today? Would we give up what we now have and go back to the old technologies that we so fondly remember?

When I was being taught how to become a happy inhabitant of "Fruitcake Land," had I been able to see into the future and witness the inhabitants of planet Earth using their smartphones and talking to people across the planet, I would have thought it was magic. Even now, knowing something about how these devices were developed and the infrastructure that supports them, their pure genius is breathtaking.

IMAGINATION

> *When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.*
>
> ARTHUR C. CLARKE (CLARKE 1964)

Imagination is the fuel used to bake the special fruitcakes that flow out of "Fruitcake Land." Failure of imagination would stifle creativity, excitement, and development and result in a society of humans who have stopped doing what they love to do. Whatever it is, we love to use our imaginations, see possibilities, and create. In spite of all naysayers and skeptics, humans push forward following their instincts and doing what they love.

Imagine then, if you will, being in a time machine and having the choice of being transported into the future or the past to witness activities on Earth in various cultures. You could trace the development of technologies from the beginning of the Industrial Revolution up to the present day. How communication devices have evolved, how transportation has changed. The electronics industry and the changes to television and radio. The creation and development of personal computers, and most startling, specifically in the electronics industry, the increase in functionality of the devices while at the same time how the cost of purchasing them decreases over time.

In 1974, I purchased a 27" Zenith television for $750. In 2022, I can purchase an internet-ready 27" flat screen TV, with greater picture quality

than I could have imagined in 1974, for $150, and have it delivered to my door in two days. These advances can be traced to a quantum leap in progress in the electronics industry after the invention of a unique device in 1947. On December 23 of that year, William Shockley, John Bardeen, and Walter Brattain demonstrated the transistor at Bell Labs in Murray Hill, New Jersey.

Since then, transistors have made their way into most products that require electricity to operate. In 1972 they became a critical component in Liquid Crystal Displays (LCD) when T. Peter Brody and his team at Westinghouse incorporated thin film transistors in the first Active Matrix (AM) LCD. It didn't take many years after this until LCD screens replaced Cathode Ray Tube (CRT) screens on all computer monitors and television products, and as time passed, they began to appear on many other products too—even refrigerators.

As we sit in our time machine, we can't help but be tempted to go forward in time to see in what direction these technologies go and how far they reach. What present day technologies will be replaced by transformative technologies developed in the future? Will the transistor eventually become obsolete? Will it be replaced by an unforeseen/unanticipated discovery or invention that defies our current understanding of physics, one that will deliver greater performance for less cost? What limits are there to invention?

In 1902, Charles Holland Duell, who served as the United States Commissioner of Patents from 1898 to 1901, said, "In my opinion, all previous advances in the various lines of invention will appear totally insignificant when compared with those which the present century will witness. I almost wish that I might live my life over again to see the wonders which are at the threshold." Duell is also credited, by legend, with having said, "*Everything that can be invented has been invented*." This attribution has been dismissed for lack of evidence and is possibly linked to a joke that was published in *Punch,* a British comedy magazine. Duell died on January 29, 1920, at the age of 69 (Wikipedia).

How true do his prophetic words ring today when we can look back and see what wonders *were* at the threshold when he died?

What about other technologies? Will future inventions and developments see humans and their technologies settling on another planet? Considering that there were many advances in science and engineering born

of the endeavor to reach the moon in the 1960s, I would say without hesitation that before a colony has been established on the Moon, or Mars, there will be significant advances in applications of technology along the way. When reflecting on what might exist 50 years in the future, it becomes mind-boggling to consider advances in technologies if they continue at the same pace they have had in the past 50 years.

In considering these possibilities, we might want to add into the mix a tantalizing and challenging demonstration of flight technology that may exist in the future, after suitable discoveries and invention take place. *This technology is already dancing before our eyes today.*

On June 25, 2021, a report was issued by the Office of the Director of National Intelligence (ODNI) that accepted the existence of UAPs (unidentified aerial phenomena), also referred to as UFOs (Unidentified Flying Objects), in US air space, and felt the evidence for their existence warrants further investigation. While dismissing many UAPs as natural phenomena or optical aberrations, the report admitted that some UAPs are genuine and exhibit abilities such as accelerating at great speed and sharply changing direction without slowing down. The capabilities of these craft far surpass what US technology is capable of, and presumably that of other countries as well, though the ODNI stops short of suggesting that they may have extraterrestrial origins.

> The US Navy recently admitted that, indeed, strangely behaving objects caught on video by jet pilots over the years are genuine head-scratchers. There are eyewitness accounts not only from pilots, but from radar operators and technicians.
>
> In August, the Navy established an Unidentified Aerial Phenomena (UAP) Task Force to investigate the nature and origin of these odd sightings and determine if they could potentially pose a threat to US national security.
>
> The recently observed UAPs purportedly have accelerations that range from almost 100 Gs to thousands of Gs—far higher than a human pilot could survive. There's no air disturbance visible. They don't produce sonic booms. These and other oddities have captured the attention of "I told you so, they're here!" UFO believers.
>
> But there's also a rising call for this phenomenon to be studied scientifically—even using satellites to be on the lookout for possible

future UAP events. (ODNI 2021).

Without a clear answer as to where the advanced civilization that developed these craft is located, observing their performance makes one wonder what other advances would be apparent in the place where these machines were built. If we had the ability to be transported to that place where the inhabitants had been developing their technologies for perhaps thousands of years, not just hundreds as we have here on Earth, what would those technologies look like? By observing from a distance, what could we learn about them? Would we be like a child in the ’50s peering into the future and seeing everybody using smart phones? It would probably all seem like magic to us. What would their cities look like? Equally important, what would the infrastructure needed to support this civilization look like? One would think that incredible knowledge and advances would feed into and be evident in all aspects of power generation, production, transport and services to maintain life.

Observing how these UAPs function leads one to conclude that the craft does not rely on burning fossil fuel to operate. They seem to be surrounded by some kind of corona or energy field, and there were no observations of fire bursting out of jet engine afterburners when a UAP was seen to accelerate at great speed. The UAP appeared to have total control over gravity and navigation. I can’t help but think that if we were able to visit the place that created the craft, we’d find other examples of technologies that we don’t have.

- Would we recognize the power plants that allow their civilization to operate?
- Does the civilization that created that craft use steam to rotate turbines to create electricity, or burn refined oil to power their vehicles the way we do?
- Outside their cities, at a comfortable distance away, would we see long vertical structures with smoke billowing out of the top?
- Would we see large engines on iron rails pulling hundreds of cars full of fossil fuels, such as oil and coal, destined to be burned to create the steam to drive turbines?
- Would we find oil refineries converting oil into gasoline to fuel their vehicles, or factories that convert oil into rubber that is used to make

wheels for vehicles that roll along millions of miles of paved roads?

Surely if the UAP we have witnessed is any indication, we would probably see similar futuristic craft that magically whiz by at various elevations above the ground with barely a whisper of sound.

While the implied advanced technology demonstrated by UAPs may be a hundred or even a thousand years ahead of ours (though it is probably a mistake to characterize advancement as a reflection of years), it shows clearly that they have already mastered and can control the effects of gravity and inertia on physical objects and have an efficient propulsion system. The combination of both allows them to hover, accelerate at tremendous speed, make a 90-degree sharp turn, and descend from 80,000 feet to the surface of the Earth in a few seconds. On a craft built today, these movements would result in g-forces that would destroy the craft as well as the humans inside. It seems unlikely that a civilization that had hundreds of years of technological development would be relying on the same technology to fuel their society that was developed when they were taking their first steps along the path of technological progress.

FULL STEAM AHEAD

Here on planet Earth, the fundamental physics, science, and invention that allow us to travel, power our magical devices, and many other applications, have stayed basically the same. While quantum leaps in progress were being made in controlling how electrons behave within a device, the principal methods of power generation that harness and provide the electrons for the device have stayed fundamentally the same for over 100 years.

Excepting hydropower, power plants and engines still rely on motivation provided by a buildup of pressure from a gaseous medium. For coal, oil, gas and nuclear-fired power plants, it is steam, and for internal combustion engines, it is the explosion of gasoline or diesel fuel in an enclosed cylinder.

Taking all of this into account, it would seem that the infrastructure we have today, innovatively, has not kept pace with the rapid development of new technologies and the explosive growth of consumer use. In the past, as consumer products were invented and introduced into society, electric

power generation companies have adapted by building more steam-driven power plants. Lately, there has been a greater investment into solar and wind energy. But is that enough? And even if it was, is it the best and most efficient way to harness energy?

Due to a combination of political and technical influences, we are heading toward a crisis in energy delivery. Shifting political agendas desire the use of less oil, gas, and coal—the lifeblood of automobiles and power plants—and more use of public transportation and electric cars. Without turning to alternative means of generating electricity in the same quantity that fossil fuel-fired power plants produce, which in our world means *nuclear,* this would increase the demand for electricity while reducing the supply. Electric car manufacturers might serve their customers better and sell more cars if they can ensure a continued supply of electricity, using their genius to reinvent energy production and build their businesses around the results. Could an electric car eventually ditch its battery and be powered by a pyramid electron harvester, with relay stations positioned like cell phone towers?

Twenty-five years have passed since the publication of *The Giza Power Plant: Technologies of Ancient Egypt*. Since then, a lot of new information has been gathered by myself and other researchers in many fields, and I feel a need to report on how new discoveries fit with the power plant theory and play a part in bringing the vision described above into reality.

When *The Giza Power Plant* was first published, I didn't know what to expect. The book was akin to a reverse engineering exercise, and I was aware that other interpretations of the evidence used in my analysis may be used by others to arrive at different conclusions. I was also aware that there would be pushback based on historical grounds and long-held cultural ideology. I expected all of this and received it. After all, it was a theory—not presented as a fact.

Scientific theories must be falsifiable. They have to be tested and proven beyond a reasonable doubt that they are either correct or false. To do this requires the collection of evidence. In *The Giza Power Plant*, I presented an abundance of evidence that supported my theory that the Great Pyramid was a power plant. I placed a stake in the sand of Egypt, so to speak, with the knowledge that any evidence discovered in the future would have the potential to either support or disprove the theory. Whatever is

discovered cannot be ignored and must be addressed—even if it casts doubt on a particular theory that we may support.

A theory should also be able to accommodate new information that it did not anticipate, which, when added to the body of existing evidence, makes the theory more complete. In that sense the theory is predictive. And in that sense, *The Giza Power Plant* was predictive, and evidence that has been revealed since it was published supports it. Much of it is now well-known and discussed frequently on many social media outlets. Unlike the time when I was writing the book, between 1977 and 1998, in 2022 we can find that a tsunami of information about the Great Pyramid has made its home on the internet. For this reason, much of the research that appears in *The Giza Power Plant* is not going to be rehashed here. I don't want the reader to walk away saying this book is only offering the same thing, only in a different way. Moreover, I'm not going to make you wade through reams of technical reports in order to understand the overall picture. I will summarize main points, but will include appendices at the end written by experts where technophiles can dig through the details.

This book will introduce new evidence that may be considered predictive within the construct of the power plant theory, as well as new evidence that was not predicted, but which provides more support to the theory than what was previously known. The evidence is compelling, paradigm changing, and spectacular. It more than validates the power plant theory.

In this book you will learn:

1. How, since *The Giza Power Plant* was published, further explorations of the Queen's Chamber's southern and northern shafts have discovered evidence that supports their function described in the power plant theory. In particular, there is explosive new evidence that was discovered in 2002, but languished in a desk drawer until 2021, when it was broadcast on Matt Sibson's Ancient Architects YouTube channel. What has been revealed fully supports the Giza Power Plant theory. Why this evidence has been hidden for so long is still an open question. Also, you will find an Appendix by Brett I. Cohen, PhD, who provides a different perspective and formula for the generation of hydrogen in the Queen's Chamber.

2. The discovery of scorch marks on the ceiling of the Grand Gallery, which supports the King's Chamber explosion hypothesis. While temples such as Denderah near Luxor had layers of soot that, when cleaned, revealed beautiful original paint and details, the ceiling of the Grand Gallery, when cleaned, revealed heat-affected areas burned into the limestone ratcheted ceiling.
3. The results of further acoustic testing and key measurements related to specific frequencies within the Great Pyramid's chambers and shafts. Robert Vawter's appendix will go into greater detail.
4. The stunning significance of the large void discovered above the Grand Gallery during muography detection efforts by an international group of scientific institutions. Aerospace Engineer Eric Wilson recognized immediately what this "Big Void" may have been created for and why it was discovered where is was. Also, his appendix is a paper he wrote and delivered to a conference of the AIAA.
5. The recent Russian research regarding how the Great Pyramid focuses electromagnetic energy to the center of the pyramid near the King's Chamber.
6. The exhaustive research into the phenomenon known as "earthquake lights" by a team of NASA scientists and the significance of what is known as the "Freund Effect" and how it relates to the function of the Giza Power Plant.

Of all those on the above list, the Freund Effect is probably the most significant of all, for I believe that it is these natural phenomena that inspired the building of the pyramids in the first place. Moreover, while the pyramids may have been stripped of the ability to continue to access and maximize the benefits of this effect, the effect is still there, dormant though it may mostly be, but what it may mean is that the Earth can be coaxed into providing our civilization with an abundant and inexhaustible source of electricity that will result in a more harmonious environment for future generations.

The results will affect more than one aspect of our lives as the physics at work in the Earth's crust and mantle have engendered a new understanding, and earthquake lights tell us not only where stresses are building before an earthquake happens, they also deliver another message—electrons are

released when rock is stressed, and if we can build a system that simulates that stress and harvests the resulting electron flow, we can deliver it to the myriad devices we use on a daily basis.

Rock is the essential source of the electrons, and understanding how they become active under stress makes the mystery surrounding unexplained phenomena experienced around the pyramids more understandable. It explains much of the phenomena reported about electromagnetic activity in the Great Pyramid—such as the Leyden jar experiment, when Anglo-German engineer, metallurgist, and inventor, Sir William Siemens, after feeling a prickling sensation in his index finger when climbing the pyramid, crafted a Leyden jar and shocked his tour guide with a discharge of electricity the jar had accumulated.

The piezoelectric qualities of quartz-bearing granite being the source for electron flow in the King's Chamber will also be re-examined. Friedemann Freund's research into earthquake lights, and research in the field with experienced geologist, Adrian Lungan, who provided his own analysis and opinion, have resulted in more convincing and sustainable answers to questions that have arose.

It was 12 years after *The Giza Power Plant* was published before my second book, *Lost Technologies of Ancient Egypt*, was released. This book did not discuss the power plant theory but focused on another important aspect of ancient Egyptian technology: the means and methods with which they quarried and crafted their amazing stone artifacts.

Some have argued that this book logically should be read before *The Giza Power Plant*. In some ways, I would agree with them. Its contents are certainly less controversial and can be more vigorously defended. By the time it came to writing *Lost Technologies,* I had come to the realization that if humankind's understanding of the truth about the level of technology that was known and exercised in Egypt's ancient past was to change, then Egyptian history would have to be changed by the Egyptians themselves. To that end, I inscribed in *Lost Technologies of Ancient Egypt* a dedication to "*The Egyptians and their glorious heritage*."

An amazing transformation has taken place since. Although 25 years ago, when discussing my ideas on internet forums, I was told I was a lone voice in the wilderness with nobody listening or interested, there has been a grassroots movement of technologists, engineers, and scientists who have traveled to Egypt to examine the artifacts that I discuss in my books. The

effect of this swell of interest and confirmation is that Egyptian tour guides who work with these knowledgeable and skilled travelers are now learning how advanced their ancestors were. My good friend and Egyptologist tour guide, Mohamed Ibrahim, has become a huge advocate for my work and is teaching his colleagues the truth about their ancestors using the instruments I left with him in 2019. I'm pleased to say that my books are becoming well-known in Egypt and receiving support not just from Egyptologist tour guides, but from engineers like Ahmed Adly who kindly provided the Foreword for this book, and mainstream scholars, such as Dr. Wassim El Sisi, a urologist and noted Egyptologist who discussed *Lost Technologies of Ancient Egypt* in a recent interview on Egyptian television and, recently, physicist A. L. Sherbini of Cairo University. Support is also provided by international law judge and legal overseer of the ScanPyramids mission, Hamada Anwar, as well as a leading geophysicist in Cairo, Taha Rabeh.

In 1986, during a visit to the Egyptian Museum in Cairo, my Egyptologist tour guide introduced me to a senior official. I gave him a copy of "Advanced Machining In Ancient Egypt?" This was an article I had published in *Analog Science Fiction and Fact* magazine in August 1984 (Dunn 1984). The official opened a desk drawer, tossed the article in, and wished me a good day. I never heard anything back from him. Today Egyptian minds are changing. I am no longer a "lone voice in the wilderness." Many others, both Egyptians and non-Egyptians, are inspired to lend their own voices to the subject.

My principal objective while visiting Egypt is not related to conventional Egyptology, archaeology, or rewriting Egyptian history, but to report on my own and others' observations. I began my research with a basic hypothesis that the Great Pyramid was a power plant and not a tomb. It was not until my first trip to Egypt in 1986 that I came face to face with the amazing manufacturing precision that is cut into their myriad of stone artifacts—whether these artifacts be intact statues or temples, or broken and discarded pieces surrounded by rubble. At that time, the purpose of my research expanded from a reverse engineering exercise to bringing Egyptians' attention to these special artifacts so that they may recognize the true genius of their ancestors. Should these further studies by qualified Egyptians result in a desire to rewrite their history, that should be up to them. Not outsiders.

The words I wrote in the final paragraph in the Summary chapter of *The Giza Power Plant* are as relevant today as they were more than two decades ago:

> We know very little about the pyramid builders and the period of time when they erected these giant monuments; yet it seems obvious that the entire civilization underwent a drastic change, one so great that the technology was destroyed with no hope of rebuilding. Hence a cloud of mystery has denied us a clear view of the nature of these people and their technological knowledge. Considering the theory presented in this book, I am compelled to envision a fantastic society that had developed a power system thousands of years ago that we can barely imagine today. This society takes shape as we ask the logical questions, 'How was the energy transmitted? How was it used?' These questions cannot be fully answered by examining the artifacts left behind. However, these artifacts can stimulate our imaginations further; then we are left to speculate on the causes for the demise of the great and intelligent civilization that built the Giza power plant (Dunn 1998, 225).

We are faced with a fascinating mystery. On the one hand, there have been observations in our atmosphere of a functioning machine that operates in a futuristically dazzling way. But we have no clue what technology is used that allows them to operate. Nor have we any clue how it looks on the inside. Then, surviving from deep in our past, we have the remains of a machine. We have not witnessed its operation. We know what it looks like on the inside, but it is so unique that there is nothing else like it on Earth. As much as we may want to, our technology is not sufficiently advanced to allow us to capture a UAP and study its assembly. We can, though, get closer to understanding how the Great Pyramid functioned, and I'm happy to say that I am much more confident today that I am on the right track than I was when *The Giza Power Plant* was first published.

What future will our children, grandchildren, and their grandchildren behold? Will the advances our generation have witnessed over the past 75 years continue into the future? If so, it would be impossible to imagine exactly how future generations will interact with their environment. My

studies of the Great Pyramid over the past 44 years have given me a vision of what might exist, if the science and physics embodied in the Great Pyramid is recognized and taken seriously by those in authority who can motivate and inspire action to replicate the ancient Egyptians' accomplishments.

Looking into the past, as new information becomes available, we see a landscape that is littered with stories once believed and held dear now being abandoned for the sake of progress and truth. Stories that have been passed down for generations are reexamined and either retained, discarded, or redefined as youth asserts itself in the public debate—to the benefit of future generations. While honoring and respecting those who have come before, I dedicate this book to the new generation, those already born and those yet to be born, regardless of their location in the world. They will shape a different world and create a narrative with a vision that may be impossible for people today to even imagine. In *Giza: The Tesla Connection,* I am proposing that this is a world that was lived in before, and this is a world that can be lived in again.

ONE

THE GIZA POWER PLANT

PLATEAU FEVER

The mid-1990s was a very active time in the field of what was referred to at the time as "alternative history." It seemed that all eyes were focused on Egypt and the Giza Plateau. This was a time when John Anthony West, Robert Schoch, Graham Hancock, and Robert Bauval were extremely active on the plateau. Books published by these authors became popular and were accompanied by documentaries that were broadcast to large audiences. The world, including numerous other researchers, gravitated to the Grand Central Station of ancient mysteries—the Giza Pyramids.

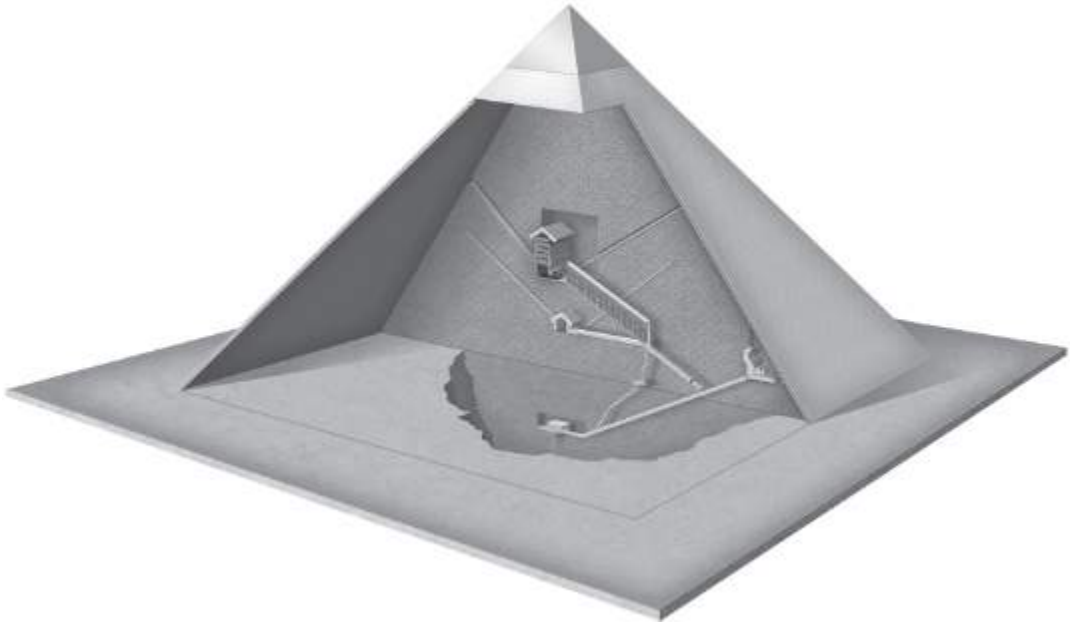

Figure 1.1. The Giza power plant.

The chief nemesis of many of these alternative history writers was the charismatic and fiery Egyptian Egyptologist, Zahi Hawass, PhD, director of the Giza Plateau. Tension existed between Hawass and some Western writers and would-be writers. By the time I met Hawass, he had already been involved in controversies involving West, Hancock, Bauval, and others, and he even had other researchers accusing him of secret digging in the Great Pyramid, where his access was said to be gained through a secret tunnel that started in a bathroom in his office.

While much of this activity may have been irritating to Hawass, the effects of it were transformative for tourism to the area. The controversy was good for book sales and viewers of documentaries and website bulletin boards, and fans of numerous researchers flocked to Egypt to witness firsthand what they had been reading. Since I first visited Egypt in 1986, the facilities that cater to tourists have undergone a dramatic transformation. The airports have been radically revamped and made more efficient. Sites that were seldom visited, such as the Aswan Quarry where lies the Unfinished Obelisk, are now fitted out with visitors' centers, bookstores, gift shops, and cafes. When I first visited Aswan in 1986, none of that was there, and my fiancée and I were the only visitors to the site at that time.

There were few tourists to deal with in 1986. Entrance to the Giza Plateau had minimal security and the entrance cost was very low. There were very few tour buses compared to the crowds they bring today. Only the pyramids themselves have not changed. But what do we expect? They haven't changed in several millennia!

In September 2001, I was with Gail Fallen, field producer for Grizzly Adams Productions, when I first met Hawass. Our first meeting took place three years after *The Giza Power Plant* was published. Remembering the reception my article had received in 1986 at the Egyptian Museum, I expected a frosty response would be given to a book with a far more controversial message, so I did not present him with a copy. He was curious to know what I did and what I was going to speak about. I simply told him I was going to discuss the remarkable precision of the stonework found on the Giza Plateau and inside the pyramids.

Having heard the rumors that were swirling around the Giza Plateau at that time, I was very curious about the rumor that Zahi Hawass, while claiming he had closed the Great Pyramid for several months to perform maintenance and cleaning, was actually continuing to perform clandestine

digging to access the end of the South Shaft of the Queen's Chamber. Following the filming of myself and Hawass (separately) on the Giza Plateau, Gail and I went to his office near the pyramids to finish up administrative work and take photographs. Hawass laughingly dismissed such rumors while generously giving us written permission to enter the then-closed Great Pyramid to see the work that had been done.

Figure 1.2. Zahi Hawass and Chris Dunn.

Figure 1.3. Zahi Hawass and Gail Fallen.

We also were given permission to see the Workers' Village, of which discovery Hawass was immensely proud, and special permission to visit the Serapeum. A full account of our visit to the Serapeum and the Workers' Village—along with commentary by Egyptian architect Hossam Aboulfotouh—is contained in *Lost Technologies of Ancient Egypt: Advanced Engineering in the Temples of the Pharaohs*. An update to the Serapeum section can be read in this book in chapter eight, "Saqqara's Hidden Treasures of Advanced Technology" where I discuss the question, "Where are the machines?"

A visit inside the Great Pyramid is inspiring at any time of day, whether morning, midday, or night. It is also impressive to behold whether it is covered in dirt and dust or not. On that day, however, I saw that the stated reason for its closure was true. Cleaning had taken place, and that cleaning had revealed, in the Grand Gallery, a tantalizing detail that caused me great excitement. It was a small but enormously important disclosure that has not been acknowledged by anyone else as being relevant but holds a prominent

place in the list of evidentiary materials that underpin the power plant theory. This will be discussed in more detail in chapter four, "The King's Orchestra."

Regarding the proposed function of the pyramids as power plants, the science and technology built into their operation would most likely be considered proprietary if it were to be invented and implemented in today's corporate world. There would be no information available to the public about its interior design and various functions. In truth, there probably would not be much general public interest in venturing inside—although, depending upon the mindset of the ancient culture that supported their original construction, access to the pyramids' interiors may have been forbidden. More likely, it was impossible while they were operating. Because other pyramids of the same design, and presumed function, do not exist in other parts of the world, it is likely that the technologies that were developed and functioning in Egypt during that ancient period were guarded state secrets and not shared. But that is an opinion posited by a mind heavily influenced by modern Western values, so who knows?

It has long been held that Mystery Schools in ancient Egypt held knowledge that was only shared with certain initiates. Pythagoras, the Greek mathematician and philosopher, is said to have spent 22 years studying there, and upon returning to Greece, introduced to the West mathematical concepts that can be seen in ancient Egyptian structures today. While Pythagoras's name is now attached to the 3-4-5 right-angled triangle, the Pythagorean triangle is clearly evident in the proportions designed into ancient Egyptian statues. Other mathematical concepts that were introduced in the West by Greek mathematicians and philosophers are also evidenced in ancient Egyptian structures, such as the golden ratio (phi), pi, the ellipse/ellipsoid, and the Fibonacci sequence (Dunn 2010, 40–67).

REVERSE ENGINEERING—TRICKS AND SECRETS OF THE TRADE

The sharing of knowledge and enlightenment from people in one part of the world to people in another part of the world can be seen by an objective observer as a positive development. I know of no objections by the Egyptians to Pythagoras, a foreigner, exporting what he learned in the Mystery Schools in Egypt to his home country, Greece. Since the Industrial

Revolution, though, the free flow of knowledge has become more restricted when affecting trade and a person's ability to make money. Trade secrets do not always end up being protected by a patent, and patents do not always completely halt the exportation of knowledge. A patent can provide inspiration for a competitor to improve on the usefulness of the invention and file for their own patent.

Exporting trade secrets from one group of people to another, whether permitted or not, has been going on since invention began. Perhaps the most famous case is the exportation of the cotton spinning mill from England to the United States by Samuel Slater in 1789. The machine brought by Slater to New York was not a physical object, nor was it a tube of rolled-up blueprints. It was all in Slater's head—though some have speculated that some secrets were hidden in his shoe. He had learned how the spinning mill was manufactured and operated while serving a seven-year apprenticeship under its genius inventor, Sir Richard Arkwright's partner, Jedediah Strutt.

Because it was illegal in England to export critical technologies, Slater disguised himself as a farm laborer and sailed from England while carrying nothing to outwardly indicate he was holding this protected information. Slater, celebrated as the "Father of the American Industrial Revolution," is considered a hero in the United States. No such accolades were awarded to him in his hometown of Belper, Derbyshire, where his angry neighbors referred to him as "Slater the Traitor." Time seems to have healed that wound, however, as the inhabitants of Belper subsequently forged a fruitful relationship with Pawtucket in New England, and a plaque honoring Slater now adorns his childhood home (White 1836).

Slater's exportation of technology might be considered a reverse or back engineering exercise. In the United States, he constructed what he had learned by closely studying how a machine, in this case a spinning mill, with its numerous parts designed and built by himself and others, functioned. The invention is credited to Arkwright, with some credit for his success given to previous inventors, but it is possible Slater, as Arkwright's apprentice during this period, may have contributed his own genius to its ultimate success and felt a degree of ownership.

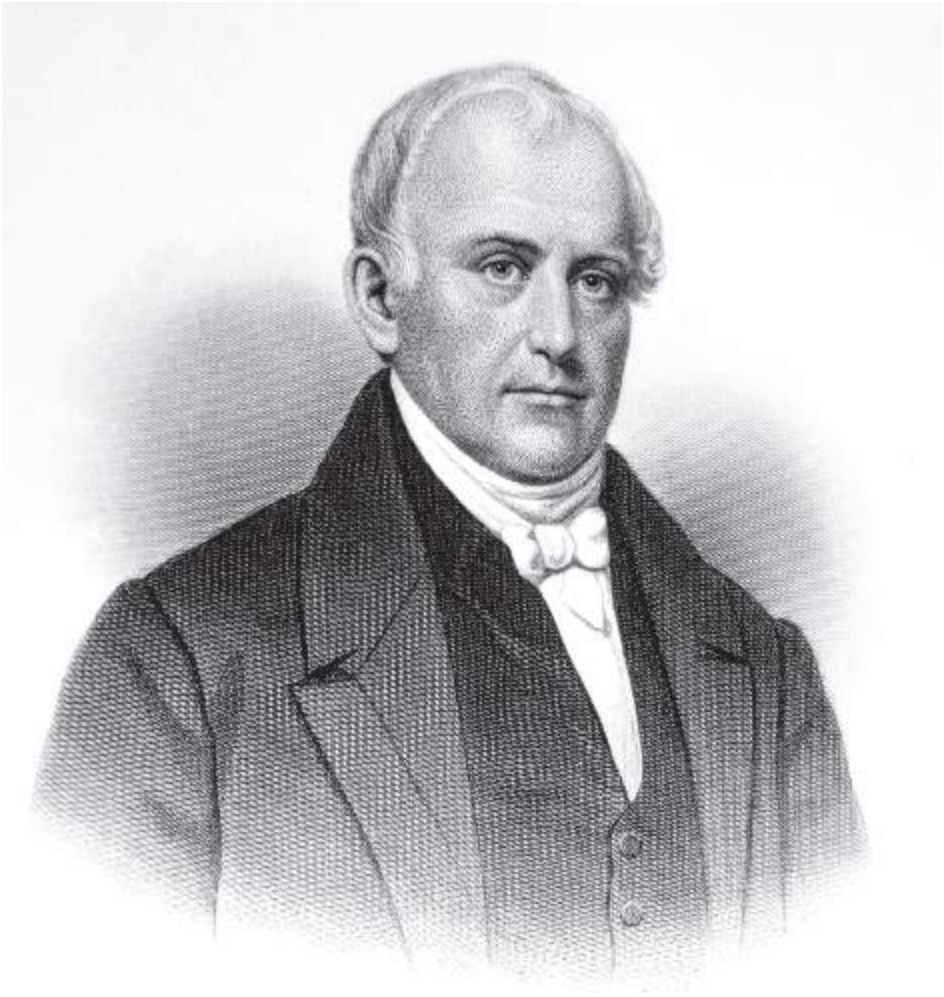

Figure 1.4. Samuel Slater (June 9, 1768–April 21, 1835).

Today, reverse engineering is a common process that is well-known around the world. Consumer product manufacturing companies understand that the beautiful, creative, and immensely functional new device they have put on the market will at some point end up in a competitor's engineering laboratory. A company may take a competitor's product—say, a vehicle—and observe its function, then take it apart, testing each individual part. Their ultimate success at creating a better version of their competitor's machine depends on their manufacturing capabilities and their ability to identify where they can make improvements. Whether the originators of technology like it or not, the diffusion of manufacturing prowess around the planet has resulted in previously poor countries lifting themselves out of

poverty and improving their lot in life. Perhaps this was Samuel Slater's motivation.

REVERSE ENGINEERING STEP ONE: EXAMINE, MEASURE, AND RECORD

Regarding the Great Pyramid, my theory that it originally served as a power plant resulted from a process of reverse engineering. It goes without saying that if we could take possession of one of these high-performance UAPs (aka UFOs), our engineers and scientists would attempt to reverse engineer it. Unlike the elusive vehicles we call UAPs, the Great Pyramid has been measured and examined closely inside and out by numerous explorers and researchers over centuries. While their understanding of the original purpose of the pyramids may have been in error, and their intentions may have been to find a hidden burial chamber, these researchers were conducting a reverse engineering task, whether they were aware of it or not. No other structure in the world has received anything like such attention over the centuries.

The list below represents the physical features that had been discovered and used when explaining the power plant theory in 1998. These details fall into three categories.

1. The discovered features were intentionally designed into the structure to perform a specific function.
2. The discovered features were a result of the machine's operation (similar to a buildup of carbon on an internal combustion engine cylinder head, for example.)
3. The discovered features were neither associated with the machine's original function nor were they the result of the machine's operation.

Each item on the following list will fall into one or more of the above categories, as indicated by [1], [2], or [3].

- Selection of granite as the building material for the King's Chamber. It is evident that in choosing granite the builders took upon themselves an extremely difficult task. [1]

- Presence of four seemingly superfluous chambers above the King's Chamber. [1]
- Characteristics of the giant granite monoliths that were used to separate these so-called construction chambers. [1]
- Presence of exuviae, or the cast-off shells of insects, that coated the chamber above the King's Chamber, turning those who entered black. [2 or 3]
- Violent disturbance in the King's Chamber that expanded its walls and cracked the beams in its ceiling but left the rest of the Great Pyramid seemingly undisturbed. [2]
- Theory that the so-called Guardians (generally identified as senior staff of Egyptian sites who held the keys to the temples) were able to detect the violent disturbance inside the King's Chamber, when there was little or no exterior evidence of it. [2 and/or 3]
- Reason the Guardians thought it necessary to smear the cracks in the ceiling of the King's Chamber with cement. [2 and/or 3]
- Fact that two shafts connect the King's Chamber to the outside. [1]
- Design logic for these two shafts—their function, dimensions, features, and so forth. [1]
- Reason for the Antechamber. [1]
- Grand Gallery, with its corbeled walls and steep incline. [1]
- Ascending Passage, with its enigmatic granite barriers. [1]
- Well Shaft down to the Subterranean Pit. [1]
- Salt encrustations on the walls of the Queen's Chamber. [2]
- Rough, unfinished floor inside the Queen's Chamber. [1 and 2]
- Corbeled niche cut into the east wall of the Queen's Chamber. [1]
- Two shafts that originally were not fully connected to the Queen's Chamber. [1]
- Copper fittings discovered by Rudolf Gantenbrink in 1993. [1 and 2]
- Green stone ball, grapnel hook, and cedar-like wood found in the Queen's Chamber shafts. [3]
- Plaster of Paris that oozed out of the joints inside the shafts. [1 and/or 2]
- Repugnant odor that assailed early explorers. [2]

The above physical features were discovered by early and more recent researchers. Other features of the Great Pyramid that influence the

fundamental nature of the structure were related to its size, interior, and exterior dimensions and relationship to the Earth. Also contributing to the theory of the Great Pyramid being a power plant were research and observations related to the acoustics of the structure. There is, however, an aspect of all research that cannot be conveyed well in written or spoken words. This is the personal experience of the researcher and their tactile and mental interaction with the object they are studying. When it comes to a structure like the Great Pyramid, I cannot stress enough how important to me this aspect became over many years and multiple visits to Egypt.

I am not alone in articulating an almost magnetic attraction to the Great Pyramid. In their book, *Giza and the Pyramids: A Definitive History*, Zahi Hawass and Mark Lehner write:

> Hawass believes there are chambers still hidden inside the pyramid, and these doors may be the keys that will open these secret rooms. Both of us have been inside the Great Pyramid many times. But it is when we are alone that the silence captures our hearts. Each chamber holds its own secrets, and each time you enter, you feel you are part of an adventure in history. When the robot went inside the tunnels in the Queen's Chamber, revealing how the stones of the interior are interlocked, it reminded us of what the Arabs said about the pyramids: 'Man fears time, but time fears the pyramids.' (Lehner and Hawass 2017, 163)

The connection with a particular place must have been the fundamental reason why the Great Pyramid and its neighboring pyramids were built where they were. One of the most recognized facts about the builders of the pyramids is that they were, at a minimum, planetary earth scientists. Today we can draw that conclusion when we examine the pyramid's relationship to the earth. Its effect on visitors within its chambers may seem like a mysterious or magical experience, but as will be revealed in a later chapter, Arthur C. Clarke's maxim may be at work here also. There may be a legitimate underlying physical aspect of nature that can be described in an evidence-rich way that may satisfy the strictest adherent to the scientific method.

While our list of evidence includes the discoveries of early explorers who revealed physical aspects of the Great Pyramid, another breed of researchers applied themselves to collecting measurements and investigating what those measurements represented. Help in looking for answers came from those who may or may not have lent a hand in collecting the information, but studied what was collected and added their own analysis. In 1859, the publisher and author John Taylor (1781–1864) published *The Great Pyramid: Why Was It Built? And Who Built It?* In performing his analysis, he used measurements taken by an English mathematician with a passion for measuring ancient monuments, John Greaves (1602–1652), as well as those taken by the French savants who studied the Great Pyramid during Napoleon's expedition to Egypt (1798–1799).

Taylor's conclusions were revolutionary for his time, but based on the measurements available to him, he stressed that the intentions of the builders of the Great Pyramid were to reflect a knowledge of the geometry and measurements of the Earth. "What reason, it may be asked, can be assigned for the founders of the Great Pyramid giving it this precise angle [of 51º 50'], and not rather making each face an equilateral triangle? The only one I can suggest is, that they knew the Earth was a sphere; and by observing the motion of the heavenly bodies over the Earth's surface, had ascertained its circumference, and were desirous of leaving behind them a record of the circumference as correct and imperishable as it was possible for them to construct" (Taylor 1859, 19).

Though not having visited the Great Pyramid himself, Taylor intuitively recognized that the work performed by John Greaves was not just a whimsical fancy that filled his time. Taylor recognized Greaves's mission: to reveal the truth. Taylor writes:

> The wise and careful observer, from whose work we have made these large extracts, had a feeling of the future value of his calculations, which seems to have been almost prophetic. He does not tell us what expectations he entertained; but since they led him to take every precaution to ensure the most minute accuracy in all his measurements, he must have made them with a view to some such issue as that on which we are now bringing them to bear. He has left nothing unnoticed; he has omitted no remark which could in

> any way tend to elucidate the purpose for which the pyramid was built. As if he had supposed it to have been intended to serve as a standard of measure, he has anticipated every question which could have been put by any one [sic] whose object was to prove the case which we are endeavouring [sic] to support . . . . (Taylor 1859, 114)

Taylor's work aroused the interest of Sir William Flinders Petrie, who performed more-accurate measurements a decade later. That Petrie's measurements differed from Greaves's is not surprising considering that Petrie, the son of an engineer, was a trained surveyor and as such was more qualified than Greaves to take measurements using state-of-the-art metrology equipment of that period.

From experience, I can say a decade makes a lot of difference in what becomes available in terms of not just knowledge but also the introduction of new tools to assist in gaining more accurate knowledge. In 2001, the instruments I took into the Serapeum were simple rudimentary gauges: a precision toolmaker's square and a straightedge. Over a decade later, Egyptian engineer Ahmed Adly procured a Bosch digital laser distance measure and a digital protractor. I have been retired for 10 years, but in 2023, my son, Alex, if he gained access and permission to do further studies of these boxes, might use a Hexagon AS1 scanner with a Leica AT960 laser tracker to gather a three-dimensional point cloud that could be downloaded by anyone to study. Time and technology move on, and who knows what will be available in 2033?

It is important to remember, though, that while today's measuring instruments are the results of decades-long development and are superior to the instruments Greaves and Petrie used to take their measurements, theirs were superior to those found in the archaeological record and displayed in museums.

Was the ancient pyramid builders' knowledge of our planet limited to just its physical dimensions or did it include the nature, concentration, and movement of the energy it contained? Assuming the answer to that question was yes and their knowledge of the Earth did not end at its surface, I wrote in *The Giza Power Plant*:

> As electrical energy can create mechanical vibrations (perceived as sound by the human ear), so in turn can mechanical vibrations create electrical energy, such as the previously mentioned ball lightning. It could be theorized, therefore, that with the Earth being a source for mechanical vibration, or sound, and the vibrations being of a usable amplitude and frequency, then the Earth's vibrations could be a source of energy that we could tap into. Moreover, if we were to discover that a structure with a certain shape, such as a pyramid, was able to effectively act as a resonator for the vibrations coming from within the Earth, then we would have a reliable and inexpensive source of energy. (Dunn 1998, 130)

PLEASE, EARTH, CAN YOU SPARE US A FEW ELECTRONS?

As it turns out, when I wrote *The Giza Power Plant*, my perception of the full nature of the energies that influence the Giza Pyramids was insufficient. There is now much more information available to add to the body of knowledge supporting the power plant theory. That new information now provides me with much greater confidence than before that an untapped source of green and clean energy exists under our feet. Perhaps we could reduce our reliance on fossil fuels and eliminate many expensive and destructive practices just by coaxing the Earth to give up not oil or coal or gas but only the electrons we need.

Create a pact with the Earth. We will stop burning you to create steam to rotate turbine blades that rotate generators from which we harvest electrons, if you will provide us with just the electrons. Considering the number of electrons involved in the generation of steam, how could the Earth pass up such a deal?

In the 1970s, we were told that in about 20 years we would be receiving electricity from nuclear fusion power plants. Then we breezed through the 1990s, the 2000s, and the 2010s, and here we are in the 2020s still waiting for cheap unlimited amounts of fusion energy. But not to worry, they are working on it, and according to an article in *Forbes* magazine published in 2019, we should have it by around 2050:

> The International Thermonuclear Experimental Reactor (ITER) project under construction in Cadarache, France, is the most celebrated Tokamak-style reactor in existence. The multi-billion dollar, 35-nation effort including the United States, Russia, China, India, the European Union, Japan and South Korea is now on pace for a 2050 commercial debut after a number of cost overruns and delays. (Cohen 2019)

Nuclear fusion is the most desirable type of nuclear energy. Sadly, though, we don't have any. The fission plants in use today are viewed with suspicion by environmentalists and others, who point to the dangers involved when things go wrong. Certain examples provide a basis for concern, such as the infamous Chernobyl accident, which laid to waste a region north of Kiev in Ukraine. Then there was the dramatic evacuation of residents when radiation escaped the Three Mile Island nuclear power plant in the US after the Unit 2 reactor suffered a partial meltdown in 1979. The most recent and dramatic example that continues to provide fuel to the anti-nuclear-fission environmentalists' fire is the Fukushima Daiichi nuclear disaster—a perfect example of where not to build a nuclear power plant. Earthquakes, tsunamis, and nuclear power plants do not mix!

It seems we are in a bit of a predicament. Will we eventually be forced to stop burning fossil fuels? There are those of the opinion that we have barely scratched the surface of the Earth to exhaust it of its resources. Nonetheless, others wonder whether we should do it gradually and willingly or wait until there is nothing left? Some reports claim that in 2016 the world consumption of coal was estimated to be 8,561,852,178 short tons. With estimated world reserves at 1,139,471,430,000 tons, this means that in 133 years, if new sources are not identified, the world will run out of coal (Worldometer). Mining, transporting, and processing coal relies on numerous ancillary industries and incurs enormous cost. The future of oil is even more desperate, with some sources estimating that, with known reserves currently being 1,650,585,140,000 barrels and consumption averaging 35,422,913,090 barrels per year, the world will run out of oil in 47 years unless significant new sources of oil are found. (Worldometer). Fossil fuels are finite resources and eventually may not be available to us in the quantities used today or projected to be used in the future. How accurate these figures are remains to be seen, but even an optimistic vision of the

future leaves you with the sense that the clock is ticking. What are we doing about it?

Reducing the demand for oil by using more electric vehicles does not solve the problem if, to generate more electricity, we have to burn more coal and oil. Oil that is refined to create gasoline that is no longer needed to power vehicles could be redirected to power plants, but how many more years will that provide to us?

For over 100 years we have primarily been living in a fossil-fuel-fired Steam Age. In the 1950s, following advances in nuclear physics, power companies added nuclear fission to their arsenal of electricity-producing fuels. However, despite the source of heat, the process of creating electricity was the same: Boil water to create steam, which, under pressure, pushes and rotates turbine blades. Our major electricity-generating technologies are based on the discovery of fire by primitive early humans. Even modern jet engines used to propel millions of people all over the world every year are simply a sophisticated use of fossil-fuel-consuming fire.

When I wrote *The Giza Power Plant,* I tried to gauge the response of readers. One of the options I considered was to write the book as a science fiction novel. This was because the conclusions I was coming to, when compared with the current state of accepted answers regarding our past, and particularly about the Great Pyramid, really did sound like science fiction or, as Professor Rubinstein put it, "straight out of Fruitcake Land"—and to many, it still does.

Ultimately, I decided not to shade my convictions, and I wrote: "Let me make no apology for the theory I am proposing. The Great Pyramid was a geomechanical power plant that responded sympathetically with the Earth's vibrations and converted that energy into electricity" (Dunn 1998, 151).

HARVESTING A BUMPER CROP OF ELECTRONS

Today, with the valuable list of the evidence that has been revealed since, including the recently discovered "Big Void" and features revealed in the Queen's Chamber's North Shaft, my previously strong convictions are even stronger. While making a slight change to the wording, I'll say again that I make no apology for the two questions I am asking:

1. Can an abundance of electrons be harvested without burning fossil fuels or creating nuclear reactions?
2. Were the ancient pyramid builders simply farming electrons with their pyramids? Could the pyramids be described as electron harvesters?

Electron harvesting is not a new concept. A quick internet search provides many sites that discuss the topic. I presented the above as two questions, rather than one, because even if we are not yet ready to accept the premise surrounding question two, I believe that to support our desire to reduce our use of fossil fuels and develop new sources of energy, question one should be given serious consideration.

A proposal that pyramids are a technical solution for our constant need for electricity introduces a level of complexity when considering the pyramids' place in history books. While new sources of energy, along with technologies for their extraction, would bring the world relief, there is strong resistance to rewriting our history books if Egypt's pyramids are recognized for what they truly are.

Nonetheless, according to Ahmed Adly, a quiet revolution of ideas in Egypt is already affecting the Egyptological community. This is a very positive development, for sustaining a mainstream belief system that is lacking in evidence becomes harder and harder as the population becomes more educated. A growing number of professional young people in Egypt are now questioning the stories they have been told about their history. Some, like Ahmed Adly, Mohamed Ibrahim, Yousef Awyan, and others are employing hard scientific principles and modern instruments to reexamine the evidence.

Egypt's youth are taking the reins and leading the charge to restore the truth about their ancestors. They are pointing out that what they were taught in school were stories regarding Egypt's past that were formulated in the Western world by scholars, astronomers, engineers, and philosophers from the Victorian era to the present, and they are passionate about correctly interpreting their ancestors' brilliant accomplishments and elevating the prestige of Egypt in the annals of history. At the same time, they are doing it respectfully and kindly, without animus. In the next chapter, we will examine new evidence that sheds light on the path toward realizing Tesla's

dream of wireless “free” energy while at the same time correcting a misunderstanding of world history.

TWO

THE GIZA-TESLA CONNECTION

> *We are whirling through endless space, with an inconceivable speed, all around everything is spinning, everything is moving, everywhere there is energy. There must be some way of availing ourselves of this energy more directly. Then, with the light obtained from the medium, with the power derived from it, with every form of energy obtained without effort, from the store forever inexhaustible, humanity will advance with giant strides. The mere contemplation of these magnificent possibilities expands our minds, strengthens our hopes and fills our hearts with supreme delight.*
>
> NIKOLA TESLA

Because my research in the past focused principally on the Great Pyramid and paid little attention to all other pyramids in Egypt, I have been accused of suffering from what some critics have called "Great Pyramid isolation syndrome." This is evidently a mental condition experienced by those who focus on just the Great Pyramid to the exclusion of over a hundred other pyramids in Egypt. My simple response to those accusations is: With no, or slim, evidence, Egyptologists claim that all of Egypt's pyramids were built to be tombs. With an abundance of robust evidence, I will theorize that all of Egypt's pyramids were built to serve a more practical purpose, that is to harvest electrons contained in igneous rock in the Earth's lithosphere.

Figure 2.1. Tesla's Wardenclyffe Tower.

The fundamental science that supports the Giza power plant theory is the same understanding of nature that is embodied in every other pyramid in Egypt. It is, as Ahmed Adly specifically noted, "*the power generated from an exceptional understanding of the physical properties of the rocks*." While Adly was referring to the ancient Egyptians' presumed knowledge and understanding of rocks, today, fortunately, we have scientists who, in my opinion, have recovered that lost knowledge—and what they have discovered has the potential to transform the planet in ways we cannot even imagine.

WHEN ROCKS GO CRUNCH

When it comes to landscaping, the immense forces that create breathtaking natural wonders make our endeavors seem insignificant and small. Reminders of these awesome and destructive events occasionally shake us from our peaceful enjoyment. One such reminder came on December 26, 2004, at around 7:58 a.m. local time (UTC+7), when innocence on the shores of South East Asia was stripped away as a large region of the ocean floor where tectonic plates meet suddenly thrust upward, lifted the water above, and caused a devastating tsunami. Vacationers near the water's edge in a bay area were puzzled when the sea receded and revealed acres of sand; some ventured out toward the ocean before the sea returned with a vengeance. Wave heights up to 100 feet (30 meters) engulfed these and other happy vacationers who were simply enjoying the idyllic beauty of a paradise provided by nature and modern humans. Fourteen countries were tragically affected by the tsunami, during which an estimated 228,000 people lost their lives (Pacific Coastal and Marine Science Center 2018).

The Sumatra-Andaman earthquake, as it is called in the scientific community, occurred in the Indian Ocean north of Simeulue Island in an undersea fault line where the Burma and India plates converge. Near the western coast of northern Sumatra in Indonesia, a vast amount of energy measuring 9.1 on the Richter scale and equivalent to 480 megatons of TNT (32,000 Hiroshima-size bombs) was released. If harnessed, what was unleashed when the rocks went crunch contained enough energy to power every five-star hotel overlooking every beauty spot in the world for many years to come.

Preceding it three days earlier, a different type of earthquake shook buildings on the island of Tasmania off the south coast of Australia. That earthquake, centered 305 miles north of Macquarie Island, was the largest recorded since an 8.4 tremor shook the coast of Peru on June 23, 2001, killing 74 people. Had this earlier quake been the result of vertical displacement, as in the Sumatra-Andaman quake, then most assuredly the shores of southwest Australia and northeast Antarctica would have been awash with disaster.

A significant earthquake happened in the region of Abruzzo, central Italy, on April 6, 2009, at around 1:32 a.m. (3:32 a.m. local time). The L'Aquila earthquake is noteworthy for several reasons.

- Public safety workers, officials, and scientists who were responsible for alerting the citizenry to the impending destruction did not issue any alerts, and 308 people lost their lives.
- Seven members of the Italian National Commission for the Forecast and Prevention of Major Risks, six scientists, and one ex-government official were accused of giving inexact, incomplete, and contradictory information about the danger of the tremors that preceded the main quake. On October 22, 2012, each was sentenced to six years in prison, a sentence that was reversed two years later. Poor building standards were also given as a reason for the tragic loss of life.
- Precursors to the quake were detected by NASA satellites collecting infrared data. Several NASA scientists working out of the Ames Research Center in California had been studying electromagnetic precursors and a natural phenomenon called earthquake lights for over 10 years before the occurrence of the L'Aquila quake.

In *The Giza Power Plant*, I described the King's Chamber as a resonant chamber that, because of its material makeup, converted mechanical energy (vibration) to electrical energy. I quoted the work of other authors who claimed that the Aswan granite out of which the chamber was constructed was composed of feldspar and up to 55% silicon quartz crystal. With the quartz crystal subject to vibration, I theorized that the piezoelectric effect of the crystal was responsible for generating electron flow.

Because of the features and dimensions of the North Shaft that make it suitable for use as a waveguide for microwave energy, I posited that the King's Chamber complex and its shafts connecting to the outside would serve as a maser (microwave amplification through stimulated emission radiation.) The key evidences to support this theory are the North Shaft, with dimensions suitable for hydrogen radiation, and a bulbous opening in the south wall, shaped like a microwave horn antenna, that collected the amplified energy stimulated in the resonant King's Chamber.

However, with the revelations of Freund's new physics, to only identify the piezoelectric properties of quartz to explain electron flow from granite is limited in scope. In order to activate piezoelectricity, quartz has to be stressed across a specific axis, and the random orientation of crystals in the granite do not support the idea that piezoelectricity was a significant factor. While questions persist regarding the percentage and orientation of quartz

in granite, with estimates ranging from less than 20% to over 60%, the entire discussion may be irrelevant.

In March 2018, I cohosted a Lost Technologies of Ancient Egypt tour with sound engineer Robert Vawter and Egyptologist tour guide Mohamed Ibrahim. A think tank of guests was attracted to the tour: aerospace engineer Eric Wilson, entrepreneur Carmen Miller, and numerous other highly accomplished professionals, one of whom was geologist Adrian Lungan, who graduated with first-class honors from the University of Western Australia and has had a successful 40-year career in the mining industry.

Adrian quickly impressed the guests with his quiet intelligence and his broad and specific knowledge of rocks. I was particularly impressed with his study methods at the Aswan quarries, when he picked up a piece of granite, studied it closely under a lens, and then put it to his mouth and licked it. Employing his taste along with sight and touch provided him with more information about the material makeup of the rock. Upon reflection, I was curious about this method, so I emailed him and asked about this as well as his analysis of the amount of silicon quartz crystal in Aswan granite. On August 31, 2021, he responded as follows:

> The Aswan granite is an acid-syenite which has a very specific composition in that the quartz content is very low (<5%). Robert Vawter and I discussed the piezo-electric properties of the quartz in the Aswan granite and I pointed out that just because a rock contains quartz, it doesn't mean that all quartz in say, a granite, exhibits piezo-electric properties (i.e. mono-crystalline vs amorphous quartz) and with such a minor amount of quartz in the granite, I don't believe that the electrical properties would in any way be highly significant. I have attached a paper that covers something on this topic.
>
> On licking rocks, when a rock is altered e.g. via hydrothermal fluids or by weathering, then certain clays can form. By seeing if your tongue sticks to a clay-rich rock, one can determine if the clay is kaolin (i.e. the rock has been kaolinised) or not and one may be able to work out what the clay was probably derived from and hence, the precursor. Also, when one crunches, say, a siltstone between the teeth, it feels 'gritty' when moving your teeth from side to side, whereas a mudstone feels smooth so, when not apparent,

you can bite off a small fragment of the rock and use your teeth to determine the difference between the two rock types. Smell, commonly used for sulphides (if not already visible).

Some rocks you definitely don't lick, e.g. rocks with brightly colored minerals, e.g. mercuric minerals such as cinnabar or arsenical minerals. Many of these poisonous minerals, except for scorodite (As), are brightly colored, reds, oranges and yellows, so when you see distinct minerals with such colors, it's not a good idea to lick the rock. Most geologists should recognize them. (Adrian Lungan email received on August 23, 2021)

ONE DOOR CLOSES AND ANOTHER OPENS

While the possibility of piezoelectricity from granite became more remote, I was convinced that something else had created the electric phenomena experienced by many visitors to the Great Pyramid. Sir William Siemens, an Anglo-German engineer, metallurgist, and inventor, experienced a strange energy phenomenon at the Great Pyramid when an Arab guide called his attention to the fact that, while standing on the summit of the pyramid with hands outstretched, he could hear a sharp ringing noise. Raising his index finger, Siemens felt a prickling sensation. Later on, while drinking out of a wine bottle he had brought along, he experienced a slight electric shock. Feeling that some further observations were in order, Siemens then wrapped a moistened newspaper around the bottle, converting it into a Leyden jar. After he held it above his head for a while, this improvised Leyden jar became charged with electricity to such an extent that sparks began to fly. Reportedly, Siemens's Arab guides were not too happy with their tourist's experiment and accused him of practicing witchcraft. Peter Tompkins wrote, "*One of the guides tried to seize Siemens' companion, but Siemens lowered the bottle towards him and gave the Arab such a jolt that he was knocked senseless to the ground. Recovering, the guide scrambled to his feet and took off down the Pyramid, crying loudly*" (Tompkins 1971, 278–279).

Magic seems to be a popular common cause for things remarkable but misunderstood. Consider again Arthur C. Clarke's quote that "A sufficiently advanced technology is indistinguishable from magic." Rather than being labeled as something supernatural, these phenomena might be best

explained by gathering geophysical/geoelectrical data from the Giza Plateau and comparing it to the results of research conducted by a physicist, Friedemann Freund, PhD, at NASA's Ames Research Center located in Silicon Valley, 12 miles north of San Jose, California. Answers to the mysteries of the pyramids may not all be found in Egypt. The research results of Freund and his associates may add valuable understanding about this phenomenon that influenced travelers to the Great Pyramid. Robert Vawter, now understanding after his return from our Lost Technologies of Ancient Egypt tour in 2018 that the piezoelectric effect does not play a significant role in the functioning of the Giza power plant, contacted Freund after accessing some of his research papers on earthquake lights on the internet.

Freund developed his theory during 24 years of research into the physics behind what have historically been known as earthquake lights. These lights appear in areas where there is an increase in tectonic stress, and in many cases, the lights will precede earthquakes. In the past, they have manifested as atmospheric electrical phenomena, such as ball lightning—which has sometimes been mischaracterized as UFO activity. Through satellite data analysis and laboratory experiments, Freund has discovered the underlying physics that explain how specific types of rock formations produce electrical anomalies in the Earth before and during earthquakes. Previously described in geophysics as earthquake lights, this phenomenon is now known by those associated with Freund as the Freund Effect. Freund's fundamental discovery was that igneous rocks in the Earth's mantle and crust contain dormant electronic charge carriers, and when stressed, certain types of igneous rocks essentially turn into a battery. See color plates 1–5 and Appendix B for details on his theory and discoveries.

Freund's motivation was not to solve the riddle of the pyramids, which was probably the furthest thing from his mind, but to examine a natural phenomenon that occurs prior to a seismic event, with the hope of being able to forecast when an earthquake is about to occur in order to provide adequate warning that could save lives. The evidence he has gathered to support his conclusions is impressive. The earthquake at L'Aquila is a prime example of where this type of early warning detection could be applied. NASA scientists, monitoring satellite infrared detection data, observed strong infrared emissions in the hills far from the earthquake

epicenter around the region of Abruzzo, Italy, several days prior to what is now known as the L'Aquila earthquake. This energetic discharge is directly related to the phenomenon known as earthquake lights. The infrared emissions and the earthquake lights, according to Freund, are created by the release of energy via positive electron holes from peroxy bond defects when rock is put under pressure.

These aspects of the Freund Effect are technical geophysical terms that may seem opaque to the layman, but what they mean is that under stress, underground igneous rocks of different types can release massive amounts of electrons, which quickly migrate to high points on the surface where they ionize the air, creating earthquake lights. The energy necessary to achieve this is on the order of tens of kilovolts per square inch. Considering this discovery through the lens of the Giza power theory, the Freund Effect seems to identify a source where an inexhaustible supply of electricity exists and, under the right conditions, can be stimulated to move and be harvested for use for the same reasons we now mine, burn, and blow.

Using samples of different kinds of igneous rock, such as granite, basalt, and gabbro, Freund has demonstrated these phenomena in an Ames Research Center laboratory. Of note, his results identified gabbro as responding with greater efficiency at releasing electrons than granite. This is an important discovery, as it essentially dispels the idea that piezoelectricity plays a major part in creating earthquake lights. Gabbro does not contain quartz crystals.

Lightning is an example of electrons released into the atmosphere. What if we learned how to capture those electrons and use them to power our devices? What if we mimicked the random, unpredictable, natural forces of the Earth that stimulate the release of the electrons in a way that is predictable and enables a constant, generous supply of electricity?

Freund's theory regarding the physics behind earthquake lights is the result of years of research spent collecting and testing different types of rock in his laboratory at NASA. He and his associates also learned that the rock only has to move a few angstroms (1 angstrom = 10^-10 m or 0.00000001 cm or 0.000000003937008 in.) for this phenomenon to occur. To bring this into clearer perspective, a human hair is approximately 0.0025 inches (0.0635 mm) thick. Divide a strand of hair into 635,000 parts and you will have one angstrom. The Earth is a dynamic body that is constantly in motion. It is constantly releasing electrons into the atmosphere, and

according to Freund's research, it does not require much movement of a suitable type of rock in order to do so (Freund 2003, 2013).

Appendix B in this book is a transcript of Freund's lecture in Christchurch, New Zealand, in 1996, in which he explains his theory in layman's terms and asks the question, "*What if we could know when an earthquake was going to strike, days or even weeks in advance?"* The foundation for the theory is semiconductor physics and the existence of peroxy defects in igneous and metamorphic rock. He describes the phenomena as "*A new chapter in earthquake physics. A new chapter in materials science and solid-state*" (Freund 2016).

CONFIRMATION OF FREUND'S NEW PHYSICS

Although Freund's motivation behind his research into the physics underlying earthquake lights was how that knowledge may be used to predict when an earthquake was going to occur, seismologists have not universally recognized its value to them. Freund and his associates at NASA, along with the GeoCosmo Research Centre, were lone voices in geophysics and seismology until confirmation of their discovery was published by Japanese researchers who had replicated their work, which included, of course, their own laboratory experiments (Takeuchi et al. 2011).

WHEN ROCKS GO HUM

From my perspective, this discovery is enormously important to our understanding of how the Giza power plant operated. Combined with the acoustic design of the interior chambers and passageways of the Great Pyramid, everything points to the granite-lined so-called King's Chamber as being the power center where acoustic and electromagnetic energy pumped hydrogen atoms to a higher energy state. Freund's research fills in the void left by the rejection of the idea that quartz-bearing granite, when caused to oscillate, could produce sufficient electron flow through the piezoelectric effect. With supporting evidence produced through laboratory experiment, his research appears to provide an alternate mechanism based on semiconductor physics for harvesting electricity and answers the question of why it was necessary to quarry and transport thousands of tons of granite

500 miles and precisely shape it before assembling it in the center of the Great Pyramid.

In 1752, Benjamin Franklin, probably the modern era's first famous electron harvester, tapped into lightning using a key attached to a kite that was blown aloft during a thunderstorm. When threads on the wet hemp kite string were standing out straight with negative charge, Franklin moved his knuckle near the key and was rewarded with an electric spark and a shock (The Franklin Institute). Testing a theory and proving it correct while being a component in the materials used to test it was no doubt a bittersweet experience for him.

In 1879, Thomas Edison created the first dependable electric light bulb, and in the 1990s Freund started on his quest to understand the physics behind earthquake lights. Note that just over 100 years separates each endeavor. During this time, measurements, studies, and important discoveries were being made inside and outside the Great Pyramid in Egypt.

The industrial landscape has changed significantly in the past 100 years. If we project our minds 100 years into the future, what invention will be seen as having the most effect on society? Solid-state electron harvesting megamachines, perhaps?

The Giza Plateau is what fellow researcher Robert Vawter describes as a "strong area of interest" for what has become known within the GeoCosmo group as the Freund Effect. As certain types of rocks are compressed (put under a load or stressed), electrons flow out of the rock and travel quickly to the topographical high ground of the terrain. Electrons moving deep beneath the Earth can be redirected upward to the surface if they encounter a basalt dyke (a near-vertical crack, fault, or joint in the bedrock that allows molten magma to push to the surface), which acts as a wave guide.

The Giza Plateau has several of these dykes, and a future geological survey is planned on the plateau to measure the electromagnetic environment in the area. The work will be conducted by the National Research Institute of Astronomy and Geophysics near Cairo under the directorship of Professor Taha Rabeh. Knowing the natural energies and frequencies of the bedrock in that location could provide us with a greater understanding of phenomena that travelers have experienced when visiting the Great Pyramid—Siemens's Leyden jar experiment being one of them.

WHEN THE FREUND EFFECT IS FACED WITH A MOUNTAIN OF PRECISELY CUT STONE

Could the Freund Effect inspire the development of technologies that have the potential to provide us with the solution to our future energy needs? Well, it is inspiring me to discuss it, so it will be interesting to see how far it will go. It should be exponentially more attractive to power companies if they begin to understand the potential savings they would gain over current methods. The Giza Plateau's topography would seem to be the perfect candidate for maximizing the Freund Effect, though probably not quite as suitable before the pyramids were constructed as after. Now, we see artificial mountains standing with an open invitation for electrons released from deep in the Earth to rush to their peaks.

The Pyramids Exert Their Own Influence on the Electrons

In 2018, I started to receive a lot of emails regarding a recent scientific study, which concluded that the Great Pyramid, by its shape and construction materials, will focus electromagnetic energy to its center. In general, the emails I received related this research to my book, *The Giza Power Plant*, and regarded the discovery as supportive of the power plant theory. In summarizing their paper, "Electromagnetic Properties of the Great Pyramid," the authors write:

> Resonant response of the Great Pyramid interacting with external electromagnetic waves of the radio frequency range (the wavelength range is 200–600 m) is theoretically investigated. With the help of numerical simulations and multipole decomposition, it is found that spectra of the extinction and scattering cross sections include resonant features associated with excitation of the Pyramid's electromagnetic dipole and quadrupole moments. Electromagnetic field distributions inside the Pyramid at the resonant conditions are demonstrated and discussed for two cases, when the Pyramid is located in a homogeneous space or on a substrate. It is revealed that the Pyramid's chambers can collect and concentrate electromagnetic energy for . . . both surrounding conditions. In the case of the Pyramid on the substrate, at the shorter wavelengths, the electromagnetic energy accumulates in the chambers providing local

spectral maxima for electric and magnetic fields. It is shown that basically the Pyramid scatters the electromagnetic waves and focuses them into the substrate region. The spectral dependence of the focusing effect is discussed (Balezin et al. 2018).

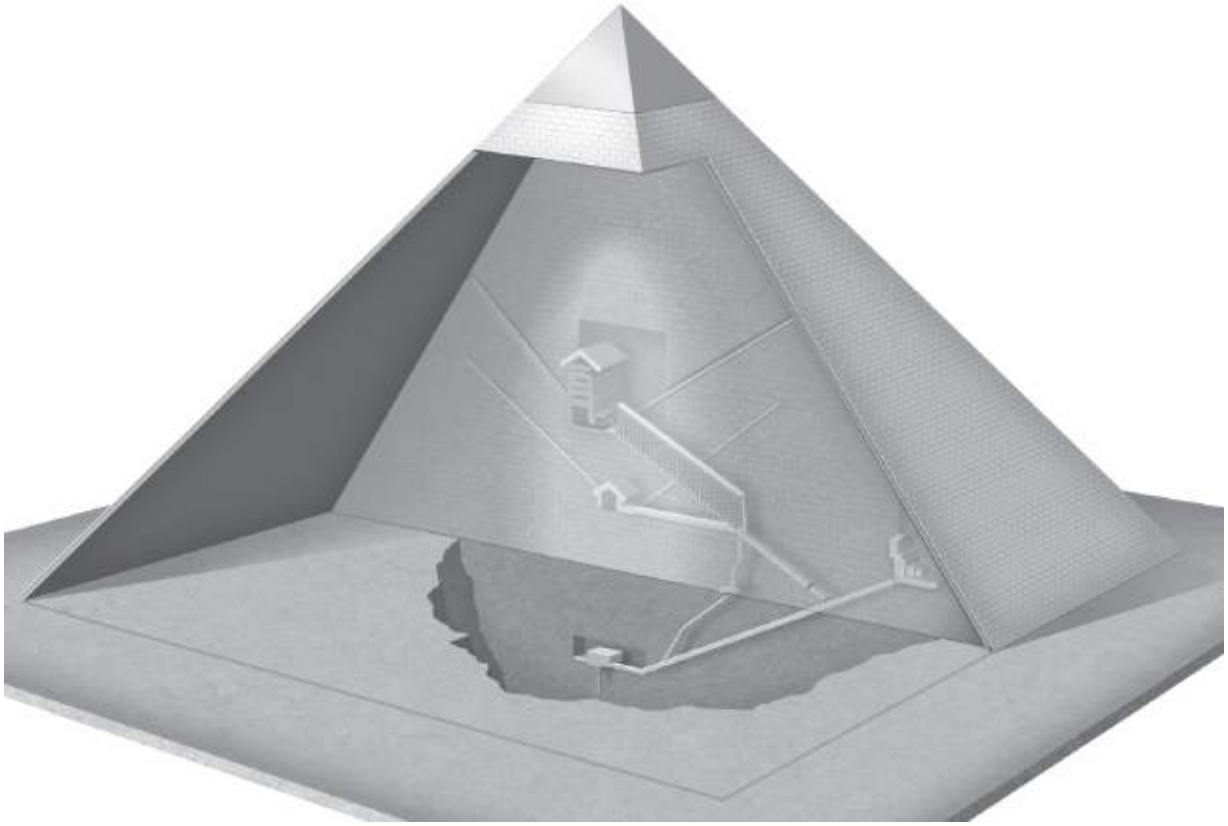

Figure 2.2. The Great Pyramid showing a concentration of electromagnetic activity at the power center. (See also color plate 6.)

The timing of these important pieces of research came to my attention during what I would consider an extremely short time span. This is quite stunning when you consider how slowly research information about the Great Pyramid has been forthcoming over the decades.

Anecdotal testimony of an electrical phenomenon associated with the Great Pyramid has been discussed for many years.

- Friedemann Freund's research identifies the source where an abundance of electrons can be coaxed from the Earth and the underlying physics that is responsible.

- A team in Japan confirmed Freund's discovery.
- A team in Russia provided the results of a study that shows how we can expect these electrons to behave within The Great Pyramid.

These separate research efforts have transpired independent of one another, and they provide a scientifically solid picture of a phenomenon that the physical evidence suggests took place. While there is still significant research to be accomplished, the scientific underpinnings now exist to explain the phenomenon known as earthquake lights. This, combined with other discoveries, fills gaps in the Giza power plant theory and brings it into greater focus and clarity. Are there other voids that still need to be explained? As it happens, there are one or two.

SCANPYRAMIDS MISSION DISCOVERY INSIDE THE GREAT PYRAMID

On November 2, 2017, a peer-reviewed article appeared in *Nature* magazine regarding a unique study of the Great Pyramid by an international team of scientists who set up muon detectors in the Queen's Chamber. Muon particles shower the Earth after being created through the interaction of cosmic rays with atoms in Earth's upper atmosphere. In the article, titled "Discovery of a Big Void in Khufu's Pyramid by Observation of Cosmic-Ray Muons," the authors describe an intriguing discovery:

> Here we report the discovery of a large void (with a cross section similar to the Grand Gallery and a length of 98.4 feet (30 m) minimum) above the Grand Gallery, which constitutes the first major inner structure found in the Great Pyramid since the 19th century. This void, named ScanPyramids' Big Void, was first observed with nuclear emulsion films installed in the Queen's chamber (Nagoya University), then confirmed with scintillator hodoscopes set up in the same chamber (KEK) and reconfirmed with gas detectors outside of the pyramid (CEA). This large void has therefore been detected with high confidence by three different muon detection technologies and three independent analyses. These results constitute a breakthrough for the understanding of Khufu's Pyramid and its internal structure. While there is currently no

> information about the role of this void, these findings show how modern particle physics can shed new light on the world's archaeological heritage. (Morishma et al 2017, 386–390)

Curiously, despite the rigorous academic and scientific process behind the ScanPyramids mission's release of information regarding what their muon detection plates had revealed about the hidden interior of the Great Pyramid, some Egyptologists denounced the find and claimed that what was discovered was already known to exist and was not new. They complained that they were not consulted about the discovery or allowed input into what was revealed to the public (Moore 2017).

Later I will discuss the exploration of the Queen's Chamber South Shaft, when a breadbox-sized space was discovered, to much fanfare, behind Gantenbrink's door and announced to the world as an amazing discovery. I find it interesting that this small space somehow deserves greater recognition than a "newly discovered" space almost the size of the cabin in a Boeing 707 jetliner.

Notwithstanding the politics at play during this exploration, the science is solid, and this feature being discovered in the Great Pyramid forces everyone to reexamine their theories. Theorists are once again challenged by new evidence and forced to accommodate the evidence or abandon their theories and conclusions regarding the construction of the Great Pyramid and its intended function. Of course, I was asked by several people what I thought about this find. I must admit I was a little taken aback by it. At the time it was announced, there was a great deal of uncertainty about the true shape of the void. The resolution provided by the muon scans did not reveal a well-defined shape with dimensionally precise walls, ceiling, and floor. What was revealed was a scattered point cloud that appeared random, and even the ScanPyramids team admitted there was not enough information to tell if the void was on the same angle as the Grand Gallery, above which it was located, or if it was horizontal. It was clear, however, that the void was very close to the North Shaft that runs from the King's Chamber to the outside of the pyramid. My initial reaction was that more information was needed before deciding whether it fit within the context of the power plant theory or not.

That information came sooner than I expected when I received a phone call from aerospace engineer Eric Wilson.

Eric is a graduate of Purdue University in Lafayette, Indiana, where he earned a master's degree in technology, and an undergraduate of Southern Illinois University, where he combined electrical and mechanical engineering in an advanced technical studies degree. I consider him to be a savant, in that his mind explores nature in ways that would make Tesla proud. In 2017, Eric contacted me after reading *The Giza Power Plant*, and as he lived only 80 miles away from me, we had lunch a few times and had long conversations about ancient technology and the pyramids. Eric had held some reservations about the maser theory I had proposed in the book, and now he called me while I was driving with Robert Vawter, who was traveling the country visiting friends and associates with his wife, Helen. (Unlike the output of a laser, a maser emits coherent microwaves, rather than coherent photons. When first invented, the laser was known as an optical maser.)

Eric had proposed that the schematic, which was based on previously discovered features inside the Great Pyramid and used when forming my analysis, was missing a preamplifier. Shortly thereafter, he learned about the Big Void in the Great Pyramid, its location near the North Shaft of the King's Chamber above the Grand Gallery, and that it appears to intersect or surround the shaft. Though more studies are needed to confirm whether the Big Void is in some way connected to the shaft, Eric explained that if it was what he thought it might be, it would resolve his previous reservations. What he had considered lacking was a preamplifier to amplify a hydrogen microwave signal before it entered the King's Chamber.

Discussing this further, we talked about what the void would need to have inside it to provide a boost to the signal. Eric said silicon quartz crystal and an electrical connection with the shaft would do the trick. He also pointed out some anomalies in the blocks near the location of the void that Gantenbrink had revealed in his drawing of the North Shaft. Further explorations in that area are necessary before drawing any conclusions about this introduction of new evidence, though it does stimulate optimism that the future will bring more enlightenment about the Great Pyramid, especially now that some Egyptians are considering the possibility of it being a power plant.

ANATOMY OF AN ELECTRON HARVESTER

A Pulse Generation Chamber
B Hydrogen Generation Chamber
C Acoustic Amplifier
D Resonant Cavity Power Center
E Chemical Feed Shafts
F Input Signal Waveguide
G Microwave Pre-Amplifier
H Maser Power Output Waveguide
I Anode
J Feedback Control
K Drain

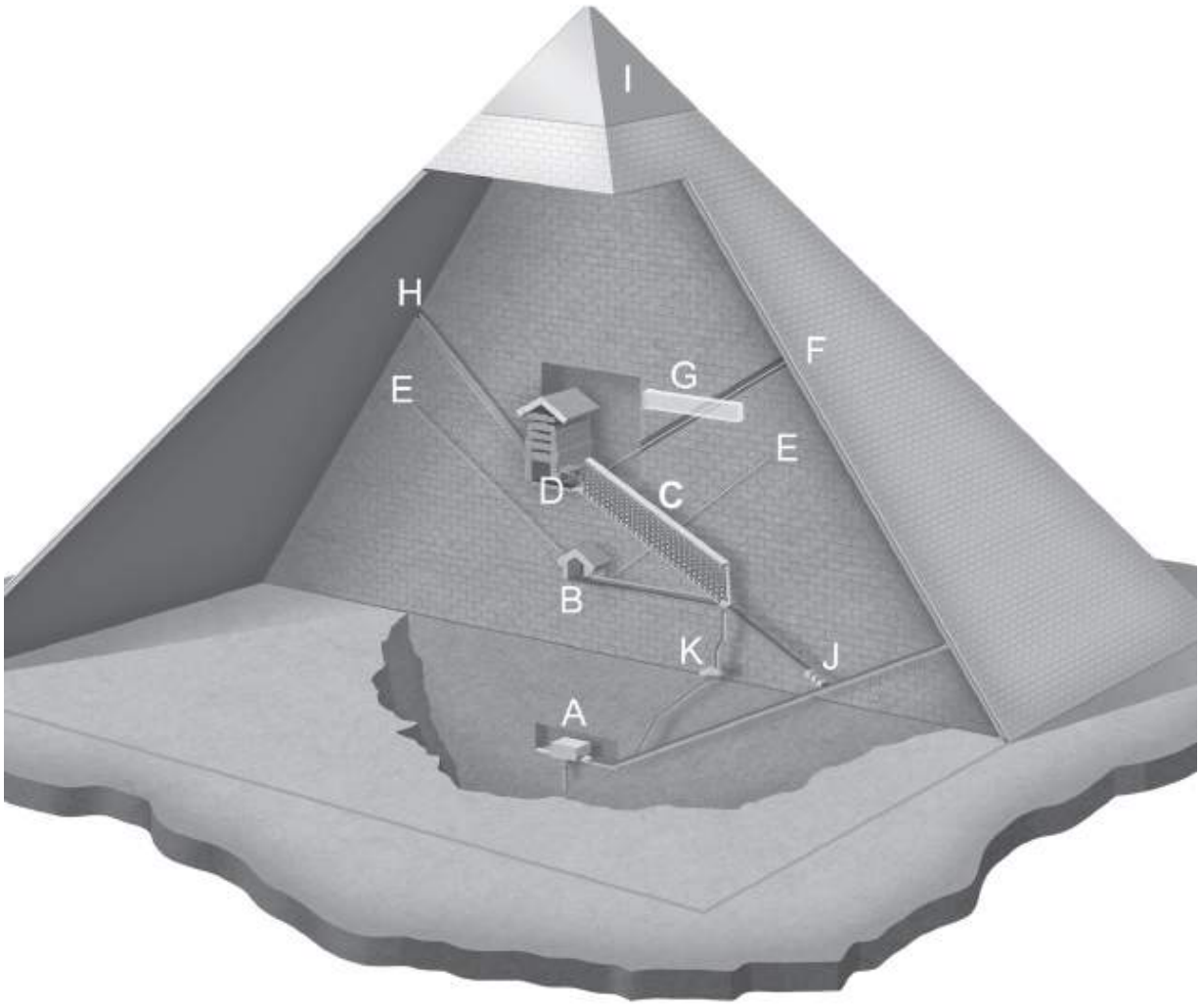

Figure 2.3. Anatomy of an electron harvester: The Big Void "preamp."

As an aside, it is fascinating to me that cavities in the Great Pyramid that contain sand seem to crop up periodically. When I first traveled to

Egypt in 1986, admittance to the Queen's Chamber was barred because a French team was boring holes in the Horizontal Passage. When the drill bit broke through into a cavity, sand poured out.

An Egyptologist who called in to the *Coast to Coast AM* radio show during my interview with George Noory on September 15, 2002, predicted that a 30-foot space filled with sacred sand would be discovered behind Gantenbrink's door at the upper end of the Queen's Chamber South Shaft. That is not what was discovered there, but what prompted her to make such a prediction? There may still be many mysteries and unseen features that could enhance our understanding of the technical function of this electron harvester, but when a large, previously unknown void in a strategic location can be seen as an integral part of the machine, how many other unknown features exist?

On September 28, 2021, I had a short meeting with Hany Helal and Hamada Anwar in 6th of October City near Giza. Both esteemed gentlemen are involved with the ScanPyramids mission. Helal is the former minister of higher education and scientific research in Egypt, and Anwar is an international judge. Helal was the mission's supervisor, and Anwar was Egypt's legal representative.

During the meeting I briefly described the contents of *The Giza Power Plan*t and gave them copies. I sensed a different reception than at the Cairo Museum in 1986 and felt encouraged to ask about the status of the ScanPyramids mission and what was planned for the future. They confirmed that further explorations were being planned but did not give details. In the meeting, I learned that Helal was an engineer specializing in rocks and mining. What better person to lead an exploration and study of the Great Pyramid? I began to recognize that a huge shift in attitudes had taken place in Egypt over the years.

Before we parted, Helal asked me a substantial question. I had previously stated that sometimes you can learn more from the questions asked than the answers given. In this case, what you learn can grow exponentially, depending on who is asking the question. The question was short, but the answer, or variety of answers, is long, and both form the basis for the final chapter in the book.

Figure 2.4. The author (center) discussing the ScanPyramids mission with Hany Helal (left) and Hamada Anwar (right).

ANOTHER SCANNING PROJECT

True to the words of Helal and Anwar in September 2021, an article appeared on Phys.org on March 1, 2022, describing a new scanning project that was being planned by a different team to verify previous findings but also reveal with greater clarity and resolution other features that the ScanPyramids mission might have missed. The article reads in part:

> The Explore the Great Pyramid (EGP) mission uses muon tomography to take the next step in imaging the Great Pyramid. Like ScanPyramids before them, EGP will use muon tomography to image the structure's interior. But EGP says that their muon telescope system will be 100 times more powerful than previous muon imaging. "*We plan to field a telescope system that has upwards of 100 times the sensitivity of the equipment that has recently been used at the Great Pyramid, will image muons from nearly all angles and will, for the first time, produce a true*

tomographic image of such a large structure," they write in the paper explaining the mission.

EGP will use very large telescope sensors moved around to different positions outside the Great Pyramid. The detectors will be assembled in temperature-controlled shipping containers for ease of transportation. Each unit will be 40 feet long, 8 feet wide, and 9.5 feet tall (12 m long, 2.4 m wide, and 2.9 m tall). Their simulations used two muon telescopes, and each telescope consists of four containers.

There are five critical points in the EGP mission:

- Produce a detailed analysis of the entire internal structure, which does not just differentiate between stone and air but can measure variations in density.
- Answer questions regarding construction techniques by being able to see relatively small structural discontinuities.
- The large size of the telescope system yields not only increased resolution, but enables fast collection of the data, which minimizes the required viewing time at the site. The EGP team anticipates a two-year viewing time.
- The telescope is very modular in nature. This makes it very easy to reconfigure and deploy at another site for future studies.
- From a technical perspective, the system being proposed uses technology that has been largely engineered and tested and presents a low-risk approach (Gough 2022).

The EGP team also promises to be able to gather data to create an accurate, tomographic, three-dimensional image of the pyramid by scanning it in slices, similar to how an MRI or CAT scan constructs an image of the human body. What this means, also, is that variations in material density will be defined, which is very exciting news and may put to rest the whole discussion about sand-filled cavities.

Don't expect results quickly, though. As noted, it is expected that the viewing time will be two years. However, as far as pyramid research projects have gone in the past, that is nothing to complain about, and in the meantime, the Great Pyramid will sit there patiently, as it has done for millennia, quietly humming its own unique melody.

THREE
PYRAMID PULSE

Everything in life is vibration.
ATTRIBUTED TO ALBERT EINSTEIN*

SINGING TO THE EARTH

For ancient Egypt's electron harvesters to work, vibration was essential. There is harmony in nature. From the cyclical frequencies of planetary systems to the frequencies of human DNA, vibration is omnipresent and influential in our lives. If it stops, we stop. That's the end. The symphony of humanity ceases to exist. Sound and music are at the core of our lives. Vibration moves us to action, startles us, soothes us, and provokes movement, whether the peaceful flow of meditation or the wild abandon of dance. When we are gathered in groups, sound entrains us with common purpose, such as with orchestral, choral, or dance performances—or even violent mob action. A single clap may stimulate the rest to join in applause.

The relationship between the dimensions of the Great Pyramid and those of the Earth is well documented and given extensive treatment in Chapter Eight of *The Giza Power Plant*, which relies on multiple sources to show that the Great Pyramid, dimensionally, is an integer of the Earth.

> The granite complex inside the Great Pyramid, therefore, is poised ready to convert vibrations from the Earth into electricity. What is lacking is a sufficient amount of energy to drive the beams and activate the piezoelectric properties within them. (Now we can add

the “Freund Effect.”) The ancients, though, had anticipated the need for more energy than what would be collected only within the King’s Chamber. They had determined that they needed to tap into the vibrations of the Earth over a larger area inside the pyramid and deliver that energy to the power center—the King’s Chamber thereby substantially increasing the amplitude of the oscillations of the granite.

Modern concert halls are designed and built to interact with the instruments performing within. They are huge musical instruments in themselves. The Great Pyramid can be seen as a huge musical instrument with each architectural element designed to enhance the performance of the other.

While modern research into architectural acoustics might focus predominantly upon minimizing the reverberation effects of sound in enclosed spaces, there is reason to believe that the ancient pyramid builders were attempting to achieve the opposite. The Grand Gallery, which is considered to be an architectural masterpiece, is an enclosed space in which resonators were installed in the slots along the ledges that run the length of the gallery. As the Earth’s vibration flowed through the Great Pyramid, the resonators converted the vibrational energy to airborne sound. By design, the angles and surfaces of the Grand Gallery walls and ceiling caused reflection of the sound and its focus into the King’s Chamber. Although the King’s Chamber also was responding to the energy flowing through the pyramid, much of the energy would flow past it. The specific design and utility of the Grand Gallery was to transfer the energy flowing through a larger area of the pyramid into the resonant King’s Chamber. This sound was then focused into the granite resonating cavity at sufficient amplitude to drive the granite ceiling beams to oscillation. These beams, in turn, compelled the beams above them to resonate in harmonic sympathy. Thus, with the input of sound and the maximization of resonance, the entire granite complex, in effect, became a vibrating mass of energy (Dunn 1998, 160).

Understanding now that electrons in igneous rock within the Earth’s mantle can be shaken loose and travel at great speed to the nearest highest

point on the Earth's surface adds much more to the theory that the Great Pyramid was a power plant. It was not just a power plant relying on seismic mechanical energy to shake a granite chamber deep in the heart of a pyramid but a massive device that was designed and built with the accuracy of a machine. Yet it also functions like a musical instrument that not only utilizes vibration and the flow of sound within its passages and chambers but also controls the flow of electrons from within the Earth. From every square meter of stone covering 13 acres of limestone bedrock on a prominent plateau 10 miles west of Cairo, a vast amount of energy from the Earth was harvested to provide electricity to the civilization that designed and constructed the pyramids. See color plates 7 and 8.

But, you may ask, if we are relying on seismic energy to put pressure on igneous rock deep in the Earth to power these electron harvesters, won't we be waiting a long time? The answer is, we don't wait. We build into the electron harvesters the means to create their own mini-earthquakes. Geologist David Bressan writes for *Forbes:*

> Tesla imagined using the waves generated by his invention for peaceful applications. One device would transform electricity into vibrations. Tesla then would use the rocks in the underground to send the vibrations to a second device. This receiving device would pick up the vibrations and transform the oscillations into electricity, to be used locally. In fact, so Tesla, [sic] the device, consisting of a piston vibrating in a cylinder, was already powerful enough to vibrate an entire building. Just one precaution was necessary. If powerful enough Tesla's machine could match Earth's frequency, causing even earthquakes. Still, in the 1930s, Tesla imagined using smaller devices to relieve energy from Earth, in this case, to *prevent* earthquakes. However, the "telegeodynamics" system by Tesla never managed to get beyond the prototype. The device was in reality not powerful enough to send energy far enough. Dampening of the oscillations by structures and the underground was far too strong. Another idea of Tesla was more successful. He imagined using the oscillations generated by his device to prospect the underground. Waves sent into the underground would be reflected by obstacles or different rocks. Observing the returning waves, a geologist may be able to see the underground. It's just this basic idea

> that modern seismologists use. Pulses of energy, generated by electromagnetic devices, controlled explosions or mechanical pistons, sent deep into the underground are reflected or deflected by geological structures. The reflected signals can then be used to reconstruct a model of the underground (Bressan 2020). [Italics added for emphasis.]

Becoming aware of Tesla's comments on earthquake prevention only recently, I did not credit him when I came to the same conclusion while writing *The Giza Power Plant:*

> The technology that was used inside the Great Pyramid may be quite simple to understand but might be difficult to execute, even for our technologically "advanced" civilization. However, if anyone is inspired to pursue the theory presented in this book, their vision may be enhanced by the knowledge that re-creating this power source would be ecologically pleasing to those who have a concern about the environmental welfare and the future of the human race. Blending science and music, the ancient Egyptians had tuned their power plant to a natural harmonic of the Earth's vibration (predominantly a function of the tidal energy induced by the gravitational effect that the moon has on the Earth). Resonating to the life force of Mother Earth, the Great Pyramid of Giza quickened and focused her pulse, and transduced it into clean, plentiful energy.
>
> Besides obvious benefits from such a power source, we also should consider the benefits that could be gained by utilizing such a machine in geologically unstable areas of the planet. As we discussed earlier, over time there is an enormous amount of this energy built up in the Earth. Eventually the weak spots in the mantle can give way to these stresses, releasing tremendously destructive forces. If we could build a device to draw mechanical energy from seismically active regions of the planet in a controlled fashion—instead of allowing it to accumulate to the destructive level of earthquakes—we might be able to save thousands of lives and billions of dollars. We would have a device that would help stabilize the planet; so rather than being periodically shaky real estate,

> California might eventually become the energy mecca of the United States, with a Great Pyramid drawing off the energy that is building up within the San Andreas Fault. A fanciful idea? Perhaps not. (Dunn 1998, 224)*

The concept of creating mini-earthquakes to draw seismic energy from the Earth in a controlled way to mitigate the occurrence of larger, more destructive earthquakes is not new, therefore. After mentions by Tesla in 1935 and myself in 1998, a different perspective was introduced in a paper published in 2014:

> Laboratory experiments performed by different teams of the Institute of Physics of the Earth, Joint Institute for High Temperatures, and Research Station of Russian Academy of Sciences on observation of acoustic emission behavior of stressed rock samples during their processing by electric pulses demonstrated similar patterns—a burst of acoustic emission (formation of cracks) after application of current pulse to the sample. Based on the field and laboratory studies it was supposed that a new kind of earthquake triggering—electromagnetic initiation of weak seismic events has been observed, which may be used for the *man-made electromagnetic safe release of accumulated tectonic stresses* and, consequently, for earthquake hazard mitigation (Zeigarnik and Novikov 2014). [Italics added for emphasis.]

Rather than using electromagnetic triggering to create these mini-earthquakes, in *The Giza Power Plant* I proposed that a mechanical device similar to Nikola Tesla's earthquake machine could be installed in the Subterranean Chamber that would periodically strike the ceiling, causing vibrations to flow through the pyramid.

> How do we cause a mass of stone that weighs 5,273,834 tons to oscillate? It would seem an impossible task. Yet there was a man in recent history who claimed he could do just that! Nikola Tesla, a physicist and inventor with more than six hundred patents to his credit, one of them being the AC generator, created a device he

called an earthquake machine. By applying vibration at the resonant frequency of a building, he claimed he could shake the building apart. In fact, it is reported that he had to turn his machine off before the building he was testing it in came down around him. *The New York World-Telegram* reported Tesla's comments from a news briefing at the hotel New Yorker on July 11, 1935:

"I was experimenting with vibrations. I had one of my machines going and I wanted to see if I could get it in tune with the vibration of the building. I put it up notch after notch. There was a peculiar cracking sound.

"I asked my assistants where did the sound come from. They did not know. I put the machine up a few more notches. There was a louder cracking sound. I knew I was approaching the vibration of the steel building. I pushed the machine a little higher.

Suddenly, all the heavy machinery in the place was flying around. I grabbed a hammer and broke the machine. The building would have been about our ears in another few minutes. Outside in the street there was pandemonium. The police and ambulances arrived. I told my assistants to say nothing. We told the police it must have been an earthquake. That's all they ever knew about it."

A reporter at that point asked Tesla what he would need to destroy the Empire State Building. Tesla replied:

"Five pounds of air pressure. If I attached the proper oscillating machine on a girder that is all the force I would need, five pounds. Vibration will do anything. It would only be necessary to step up the vibration of the machine to fit the natural vibration of the building and the building would come crashing down. That's why soldiers break step crossing a bridge" (Pond and Baumgartner 1995, 5–6; Dunn 1998, 147–149).

CADMAN'S PULSE GENERATOR

While I didn't analyze the Subterranean Chamber in detail to see what kind of machinery could be installed and function in that manner, more details regarding the Subterranean Chamber became available during my tour in 2018, when two guests, geologist Adrian Lungan and engineer Andrew Leskowitz, explored the chamber during our two-hour private visit to the

Great Pyramid. Before that, I had become very impressed with the work of marine engineer John Cadman of Bellingham, Washington.

Cadman had been emailing me information regarding his research into the Great Pyramid. He had studied and was inspired by the work of hydraulic engineer Edward J. Kunkel from Ohio, who had published his research on the idea that the Great Pyramid was originally built to serve as a ram pump that functioned through the force created by water descending through a long pipe. Kunkel's book, *The Pharaoh's Pump*, was first published in 1962 and captured the imaginations of numerous engineers and writers, including friends of mine of both stripes (Kunkel 1962).

Cadman built a model to Kunkel's specifications, but it did not function as he had described it would. Nonetheless, Cadman had the idea of scaling down his model and limiting it to the Descending Passage and the Subterranean Chamber.

He created a catchment basin on his hillside property near Bellingham, Washington, and, filling it with water, had a pipe feed water from the basin to a chamber he had made that was modeled after the Subterranean Chamber in the Great Pyramid. He added a waste gate that was, by scale, the same distance away from his model as the Great Pyramid is from the Sphinx enclosure, in the vicinity of which curious T-shaped openings are cut in the face of the rock that suggest they were connected with the pyramids on the plateau and were a part of the overall engineering scheme.

Having recently communicated with Cadman to discuss my reference to his work in this book, he shared with me by email some additional information: "The wastegate line should exit east of the Sphinx temple's midpoint–approximately 100' east and 30' below the surface. This is also the location of buried rose quartz granite that was discovered in 1980 by the Egyptian water department. This granite is not local to this area but came from 500 miles to the south (Cayce, Schwartzer, and Richards 1998, 145–146*)"* (John Cadman, email to author, May 30, 2022).

It has been reported by several researchers that the Giza Plateau is riddled with underground tunnels and deep shafts connecting them. Indeed, while walking around the pyramids on the Giza Plateau, you see several deep shafts covered with iron grates. Some shafts appear to be regularly shaped, with surfaces one might say appear as they did when they were first cut. Others appear to have suffered significant erosion, as though water had passed through them. The so-called Osiris Shaft under the causeway leading

from the Sphinx enclosure wall to Khafre's pyramid is eroded in such a way. Gaining a complete understanding of how these shafts and tunnels contributed to the overall operation of the pyramid complex is beyond the scope of this book and will have to rely on future studies by qualified scientists and engineers. Nonetheless, with evidence of shafts and tunnels in and around the pyramids, a connection with the openings that are evident in the cliff face near the Sphinx seems plausible, and it is not out of place to speculate that hydraulics, in some capacity, may have played a significant part in the function of the pyramids.

Figure 3.1. Shafts between the smaller Queen's Pyramids to the east of the Great Pyramid.

Cadman fitted the end of the pipe attached to his model of the Subterranean Chamber with a spring-loaded valve and submerged the assembly in a smaller catchment basin located downstream from the scale-modeled subterranean chamber. On opening the valve on the feed pipe and a riser pipe, water flowed into the chamber and a percentage of it was directed up the riser pipe that was attached to the top of the chamber. This

served to push out any air trapped in the chamber. When water started gushing out of the top of the riser pipe, its valve was then shut, thereby directing all the water to the waste gate.

I was intrigued by what Cadman had accomplished, although it was a departure from my thinking on the subject, and I decided to accept an invitation to come to his property and witness the operation. When I thought about the thousands of hours independent researchers have spent over the years trying to figure out the secrets of the Great Pyramid, I recognized that John Cadman had invested not just time but money and sweat devoting his life to this research. In other words, he wasn't just an armchair theorist who believed that the Great Pyramid was not a tomb but had created something that actually worked! How could I ignore such devotion and untold hours of work? In November 2005, I booked a flight to Seattle and made my way by car to Bellingham to witness Cadman's pulse generator for myself.

John was an excellent and charming host, but I wasn't his only guest that day. Jack Kolle, PhD, a hydraulics engineer specializing in hydraulic pulse generators for the oil industry, had also been invited to witness Cadman's pulse generator in operation. After breakfast, served by John, we headed to his installation, armed with umbrellas and cameras.

Figure 3.2. Left to right: John Cadman, Jack Kolle, and Chris Dunn at Cadman's pump. Image credit: John Cadman.

I was very surprised when Cadman started up his pulse generator. Something I wasn't quite expecting happened. The pipe leading to the waste gate was buried under the path, and as I was walking along the path, a slow steady beat shook the ground. However, it wasn't an ordinary beat. Its timing was 60 beats per minute, but more significantly, it beat like a heart. Lub dub . . . lub dub . . . lub dub. I was happy I had taken the time to experience this, as its effect was more profound than any distant analysis could produce.

Kolle seemed impressed. I asked him what he thought was creating the heartbeat effect. He claimed that he had no idea, but hydraulics could sometimes be considered to be a "black art," where results are achieved through trial and error, and that no computer modeling software was capable of predicting such outcomes. I then asked him if he thought what we were witnessing was the design intention of the builders of the Great Pyramid. Cautiously, he said no.

Cadman has continued to refine and build his pump and has selected another site on his property to locate the chamber inside a large gap in a

giant boulder. With his brother Mike, another excellent host who provided me with lodging for two nights when I returned in 2016, they have improved the site with a visitors center and even restrooms. In Bellingham, the Cadman passion still runs strong. Besides the Great Pyramid, John Cadman's other passion is breeding Black Russian Terriers. (His website for Sentinel Kennels provides information on his terriers, while Research Article 41 on his website provides information on his pyramid pulse generator research.)

With respect to the availability of evidence within the Great Pyramid that supports Cadman's theory, there are features of his model that have still not been discovered. A connection to the waste gate from the Subterranean Chamber has not been confirmed. When I first witnessed Cadman's model in operation, I thought that there could be a continuation of the horizontal channel that is cut in the south wall of the chamber. However, two guests who joined my Lost Technology tour in 2018, Andy Leskowitz and Eric Wilson, separately crawled down this channel and reported it was a dead end with no sign of another channel going anywhere. Moreover, both said that there didn't appear to be any signs of an opening being blocked off.

The only other place where a connection might exist is the deep well shaft in the chamber floor. Richard William Howard-Vyse was a Lieutenant-Colonel when first visiting Egypt in 1835 and was promoted to Colonel in 1837, when he joined engineer John Shae Perring in exploring the pyramids. Howard-Vyse's campaign in the 1830s revealed many previously unknown features about the Great Pyramid. While a great deal of attention has been given to his discovery of the so-called Relieving Chambers above the King's Chamber, Peter Tompkins provides a lengthy though significant caption underneath a drawing of the Subterranean Chamber that reports on Howard-Vyse's activities there:

> The subterranean pit cut deep into the bedrock is almost 600 feet directly below the apex of the Pyramid. It is 31 feet (9.45 m) in the east-west direction, but only 27 feet (8.23 m) north-south.
>
> Though its ceiling is relatively smooth, its floor is cut in several rough levels, the lowest being 11 feet 6 inches (3.50 m) from the ceiling.
>
> In the south wall, opposite the entrance, is a low passage that runs another 53 feet (16.15 m) southward before coming to a blind

end.

> In the center of the floor is a square hole, which was 12 feet (3.66 m) deep in 1838, but was dug deeper by the English explorer Howard-Vyse in the vain hope of finding an outlet for a further hidden chamber. (Tompkins 1971, 9)

Leskowitz and Wilson confirmed Howard-Vyse's account of the horizontal shaft being a dead end, and Howard-Vyse appears to have already revealed that the pit cut into the floor has no connection to any shaft that would serve as a conduit to a waste gate outside the pyramid—despite not being satisfied with reaching its termination point and proceeding to dig further down into the bedrock. Another blow to the hydraulic pulse generator theory came from geologist Adrian Lungan, who reported that he didn't see any signs in the Subterranean Chamber of the continuous movement of water. Leskowitz confirmed his observations.

Figure 3.3. Ceiling of the Subterranean Chamber.
Image credit: Andrew Leskowitz.

Figure 3.4. Subterranean Chamber pit.
Image credit: Andrew Leskowitz.

I'm disappointed that Cadman's model has not held up under the scrutiny of existing evidence. I wanted him to be correct, but just as I have been forced to accept and accommodate the mistakes I have made in my analyses, hopefully Cadman can revise his theory and produce another model that works without the proposed waste gate's function. In a recent email to me, he said that this is what his plans are: "Also, the 'dead end shaft' will be built to be a dead end of correct length. (I'll cap the [dead-end] shaft of the ink jet model. It didn't need tuning.) This was discovered after doing sound analysis last 2 years. My focus is the vortex of the sub chamber. My inspiration is Theodore Fujita's work with his tornado simulator at Chicago University. The future pulsing ink jet model is going to be as effective as Theodore Fujita's model. They designed perfect water saturated vortex for a reason" (John Cadman email received on May 30, 2022).

Obviously, Cadman's proposal that a hydraulic pulse generator was a part of an electron harvester energy system is not off the table—quite the

contrary. The question is, though, was it used in the Great Pyramid? If not, what are we left with—a mechanical device that delivers timed hammer blows to the ceiling of the Chamber? Tesla's earthquake machine?

In considering that idea, could the square depression that exists in the ceiling of the chamber be the result of constant pounding like that of a manufacturing press? Or, if Eric Wilson's large-scale acoustic engine, described in Appendix C below, which only needs a single, large mechanical blow to cause it to run continuously until interrupted is a possibility—and he has assured me that a proprietary experimental machine has been demonstrated to function this way—then the question becomes, "Am I overthinking this particular critical part of the electron harvester?" The answer is, I don't know. Possibly, but I have to continue on the path with Tesla.

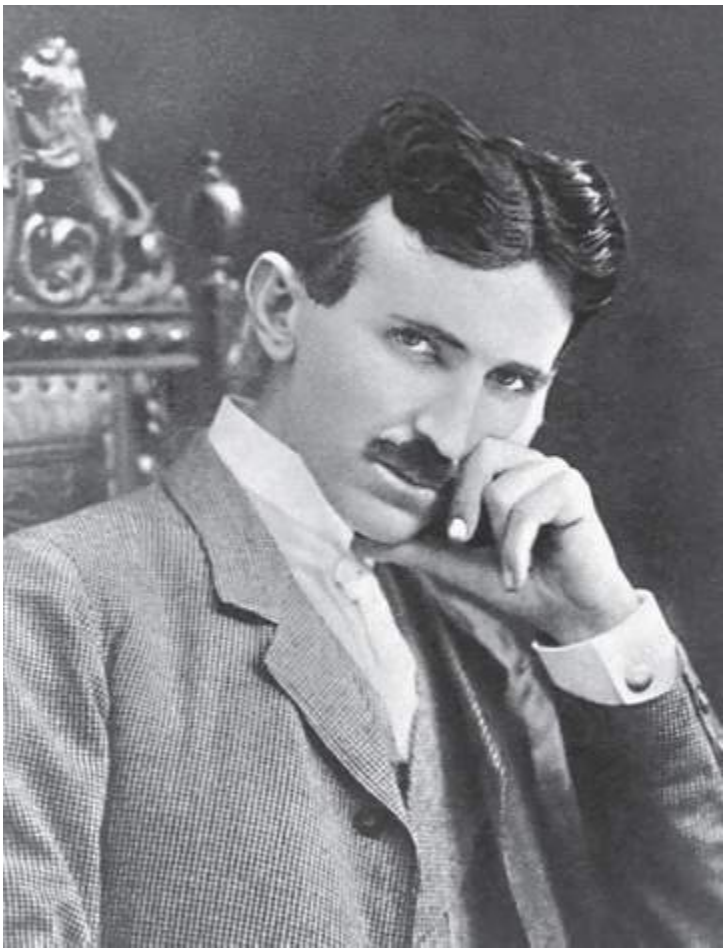

Figure 3.5. Nikola Tesla (1856–1943) at age 40.

When viewed with consideration of a Tesla-like oscillator, could the features found in the Subterranean Chamber be considered as the ground preparation for housing such a machine? With that in mind, was it a mechanical device that was installed in the pit and activated by a hydraulic, pneumatic, electromagnetic, or steam-driven piston housed in a cylinder installed in the 53-foot-long tunnel located in the south wall? There has to be some logical reason for boring out a long tunnel to nowhere. Perhaps the machinery was delivering alternating hammer blows to the ceiling, to vibrate the pyramid, and the bottom of the pit, to couple the pyramid with the Earth. Then again, perhaps it provides, as Wilson describes his machine, that necessary single blow to initiate action until interrupted and called upon again?

LIVING IN HARMONY WITH YOUR NEIGHBORS

Another consideration is that the demand for electricity may have dictated the frequency and force of the action in the Subterranean Chamber, thereby increasing or lowering the pyramid's power output. Also, we cannot ignore the Great Pyramid's lovely neighbors!

Today, large power plants provide a base load to the power grid. When more electricity is called for, smaller, gas-fired peaking power plants spring into operation to satisfy that demand. With respect to the smaller pyramids on the Giza Plateau, I wrote: "The three smaller pyramids on the east side of the Great Pyramid may have been used to assist the Great Pyramid in achieving resonance, much like today we use smaller gasoline engines to start large diesel engines" (Dunn 1998, 219).

Today I believe that the reverse may be closer to the truth. That is, the Great Pyramid stimulated output from the smaller pyramids. The electrons rushing to the surface of the Earth from deep in its mantle would not all miraculously seek out just the Great Pyramid before entering the atmosphere. Before deciding where to locate the pyramids, a study may have been performed to discover where the highest concentration of electrons naturally escapes the Earth when stimulated to move. This would be analogous to prospecting for gold, though the yield is more valuable and inexhaustible.

A complete survey of the many deep shafts and tunnels on the Giza Plateau may provide answers to the questions these speculations create, and

we may learn that the progenitor of John Cadman's hydraulic pulse generator system that caused the ground to shake lies not within the Great Pyramid, or any other pyramid for that matter, but elsewhere, and deeper underground. Created before the pyramids were built, its purpose may have been to serve all the pyramids on the plateau by shaking electrons loose from igneous rock.

It could be that the pulses generated in the Great Pyramid's Subterranean Chamber are specific to just the Great Pyramid and its performance as a maser. The big daddy of pulse generators that causes the entire plateau to resonate may not be in any of the pyramids but deep under the bedrock of the Giza Plateau, functioning as Cadman's research and model have demonstrated.

THE HUMAN ELEMENT

Knowing that all life is vibration and that vibration we know as sound affects humans, I was intrigued to receive an email from musician and composer Susan Alexjander. In September 2000, we exchanged several emails, and through those, and information on her website, Our Sound Universe, I learned about her collaboration with Professor David Deamer of the University of California, who had mapped the frequencies of human DNA. Alexjander had stepped down the DNA frequencies to human hearing range and used the result to compose music. As I had referred to Tom Danley's work in 1996–1997 when he conducted sound tests inside the Great Pyramid, Alexjander made the connection between Deamer's results and Danley's, which is that F# is a dominant frequency in both human DNA and the King's Chamber in the Great Pyramid. Susan was kind enough to send me *Sequencia,* a most enjoyable CD of her compositions based on Deamer's human DNA frequency results.

Danley's results received wide recognition when, in 1997, one of the producers of a documentary being made during his work in the Great Pyramid appeared on Art Bell's *Coast to Coast AM* radio show. Producer Boris Said reported Danley had discovered that the King's Chamber had a natural resonance approximating an F# chord between 2 and 20 hertz in the infrasonic range. He also reported that the King's Chamber floor was sitting on nodes of an eggcrate-like structure—suggesting that the ancient architects were intentionally trying to achieve an acoustical device where

damping of any vibration in the floor is minimized. This is also supported by the fact that the granite chamber is not connected, or tied in, to the limestone-core masonry, having a space surrounding the entire assembly, and the walls are not pressing down on the floor but resting on limestone-core masonry five inches (12.7 cm) below the floor level.

Danley's long-awaited article about his personal experience during the expedition appeared in the July/August 2000 edition of Live Sound International.

Asking the question "How Loud Does It Get?" Danley reported:

> While doing an FFT on the between-sweep time or quiet parts of the recording I found some very LF sound—resonances which start at a few Hz and go upward to 15–20 Hz or so. At least some of these were the same LF resonances I excited with my sweep, but not all of them. This sound was present even if everyone is silent.
>
> I crunched the results of the measurements, and they were sent on to a musicologist that was part of the staff. As mentioned, he identified that there was a pattern of frequencies, which roughly form an F-sharp chord.
>
> Not all the resonances fell in the right place but many did and some repeated the pattern for many octaves. In other words, it was roughly tuned to F-sharp over many octaves.
>
> It has been suggested (by others) that the Great Pyramid is NOT a tomb at all but actually a temple of sorts and that these resonant frequencies were "designed into" the structure. While many exotic and often far-fetched properties have been ascribed to "the power of the pyramid," I see a possible argument that some of the phenomena people experience in it may be caused by the acoustical properties that were measured.
>
> The effects of LF sound were extensively studied by various government agencies to determine the effects on humans, partly for the space program. One of the things that was discovered is that infrasound (very LF) can effect [sic] ones brain wave activity (Alpha rhythms, etc.) and other biological functions.
>
> If, as some suggest, these pyramids were constructed as a "temple" or for an initiation ritual rather than a tomb, then the LF sounds may be deliberate and have served a sacred purpose—with

the sound triggering and even forcing changes in brain wave state (i.e., one's level of consciousness) (Danley 2000).

BACK TO THE FREUND EFFECT

The human connection to vibration and how we are affected by certain frequencies became a subject of interest for Friedemann Freund and his research into preearthquake processes. It is well-known that animals exhibit abnormal behavior prior to major earthquakes. In their article titled "Unusual Animal Behavior Prior to Earthquakes: A Survey in North-West California," David Jay Brown and Rupert Sheldrake write:

> Observations of unusual animal behavior prior to earthquakes have been reported around the world since the beginning of recorded history (Tributsch 1982). In particular, the Chinese and Japanese have recorded these observations for many hundreds of years (Lee, Ando, and Kautz 1976) and have made attempts to incorporate these reports into an earthquake warning system with some success (Allen 1976). For example, on February 4, 1975, the Chinese evacuated the city of Haicheng several hours before a 7.3 magnitude earthquake largely on the basis of unusual animal behavior observations (Allen 1976).
>
> The anomalous behaviors most frequently reported include restlessness or excitability, a heightened sensitivity to mild stimulation, vocal responses, a tendency for burrowing, premature termination of hibernation, and leaving their normal habitats. The precursory lead times vary from just a few seconds to more than several months (Lee, Ando, and Kautz 1976). These unusual behaviors have been reported in a wide diversity of animal species, including many varieties of mammals, birds, reptiles, fish, and insects (Tributsch 1982). (Brown and Sheldrake n.d.)

Freund's interest in this subject was not limited to how animals were affected by impending earthquakes but also included whether evidence exists to suggest that humans also became affected. In a 2014 lecture to the

Society for Scientific Exploration, Freund presented some startling information:

> Here is something that just blew me away when I first read it. I was asked to review a paper that was first published in a book by the Russian author Alexander Shitov. In 2003 there was a large earthquake, magnitude 7.6 in a sparsely populated part of southern Siberia at the boundary between Russia and Mongolia, an area with a population of 250,000 people. After the earthquake, Shitov collected every piece of information he could find to identify what had happened before this major event.
>
> After receiving the medical records for the whole province, he found that the number of people who visited the emergency rooms had tripled starting about 10 days before the earthquake. Obviously, at that time, nobody knew the earthquake was coming, but people began to flock to the emergency rooms, complaining of various forms of discomfort and actual illnesses. Some had pneumonia, others exhibited phenomena linked to the central nervous system such as epileptic attacks, hypertension and other phenomena that clearly pointed to the functioning of the central nervous system. And so, we are starting to understand what is happening between ultra-low frequency electromagnetic waves and electron transfer processes in the single cell. (Freund 2014) Note: Transcript edited by Friedemann Freund for clarity.

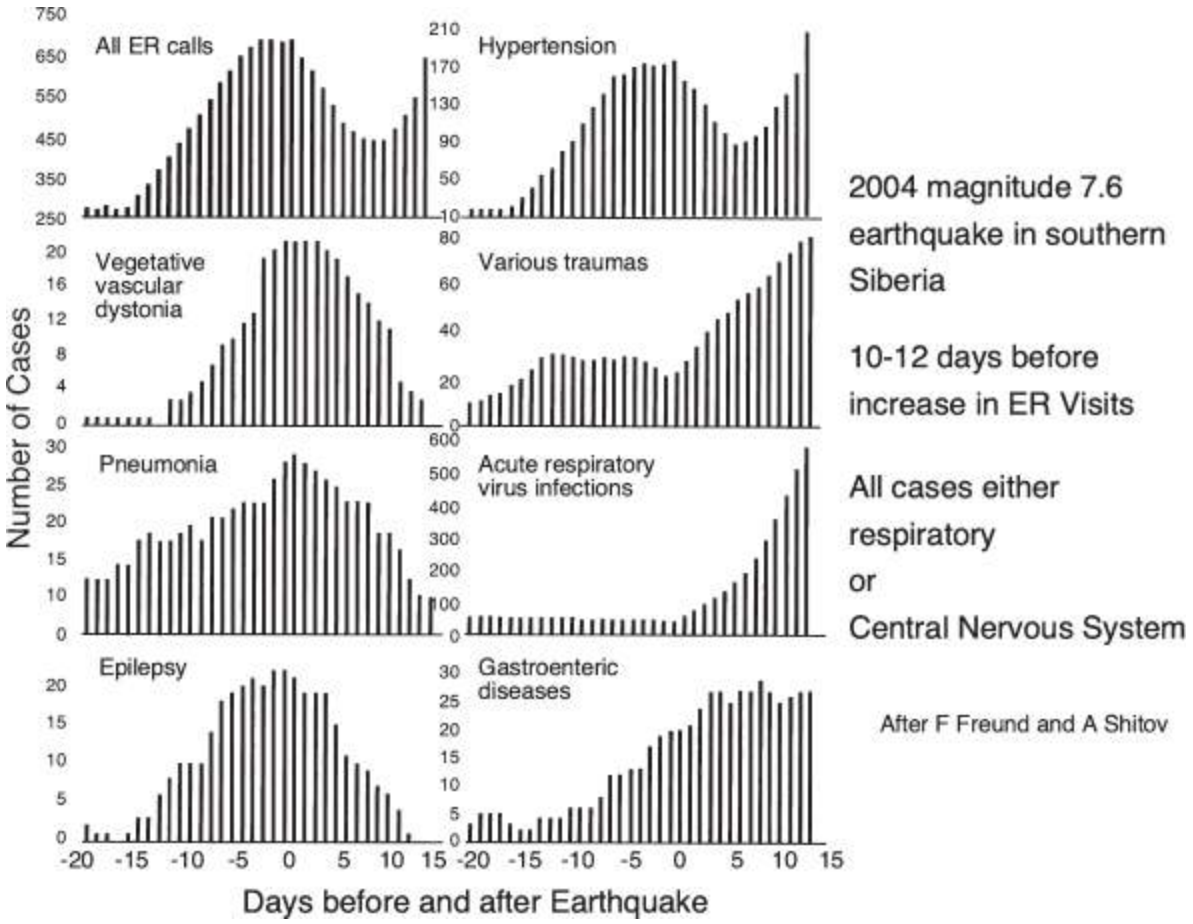

Figure 3.6. Recorded emergency room visits prior, during, and after an earthquake.

ANSWERS TO A CENTURIES-OLD MYSTERY

In *The Giza Power Plant*, I questioned the forces at play behind how I was physically affected while visiting the Great Pyramid and spending time in the King's Chamber. At the time I wrote it, I thought that skeptics would attack me for it, and I was right. However, I felt it was significant enough to include. I had no idea then that 25 years later I would be armed with answers from a surprising variety of sources and would address it again in a new book that expands on what I wrote in 1998, not just on this subject but in every aspect possible:

> Covering a large land area, the Great Pyramid is, in fact, in harmonic resonance with the vibration of the Earth—a structure that could act as an acoustical horn for collecting, channeling, and/or

> focusing terrestrial vibration. We are led to consider, therefore, that energy associated with the pyramid shape is not drawn from the air or magically generated simply by the geometric form of a pyramid, but that the pyramid acts as a receiver of energy from within the Earth itself. It could be, also, that these infrasonic sound waves provide an explanation for the physical phenomena some people have felt when entering the Great Pyramid. The "pyramid energy" that has inspired countless numbers of people since the time of Napoleon may be the effects of infrasonic sound on the brain, which is said to resonate at around 6 hertz.
>
> I experienced the phenomenon myself while in Egypt in 1986. After being inside the Great Pyramid for about an hour, I found myself in a rather uncomfortable situation. Sick and in immediate need of a bathroom, I really did not know if I was going to make it; but I rushed out of the King's Chamber, down the Grand Gallery and Ascending Passage, squeezing past tourists. Once outside I ran down the hill to the Mena House and headed straight for the bathroom. I made it just in time. The bathroom walls in the Mena House were constructed of Aswan granite. As I relaxed and closed my eyes, and without any external influence, the resonance of the King's Chamber filled my head. At the same time a pyramid shape began to glow in the center of my forehead. It was only after leaving the Mena House that this sensation faded. It could be that this phenomenon is only felt at certain times, according to the seismic activities within the Earth. I have not experienced it since then, although I have been inside the Great Pyramid several times since (Dunn 1998, 144).

I would add that infrasonic sound affects not just the brain but the entire human organism, which reacts to seismically induced energies, or the natural rhythms of the Earth, passing through the pyramid. These include infrasound as well as the Freund Effect, with the King's Chamber becoming the focal point of these energies. The combination of effects described by Freund and Danley and the Russian research team led me to suggest that the Great Pyramid was a receiver of these energies and still is, albeit not at the same level as when it was functioning as an electron harvester. I don't know

how much clearer the evidence can be to scientifically explain what has previously been interpreted to be a "mystery."

Unrelated to the Egyptian pyramids, this phenomenon has not gone unnoticed by other cultures over the years and has even influenced the selection of locations for holy, or sacred, places of worship and meditation. In "Earthquake Lights in Legends Of The Greek Orthodoxy," Igor V. Florinsky wrote:

> Local legends may contain information about real geological events of the past. Earthquake lights (EQL) can occur in the atmosphere over earthquake epicenter areas and adjacent faults before and during quakes. They may look like diffuse airglow, flashes, fiery pillars, and luminous balls. EQL may cause a mystical experience probably due to the influence of their electromagnetic fields on the brain. Subjective perception and interpretation of EQL depend on religious and cultural traditions. We study a stereotype of EQL interpretation in the legends of the Greek Orthodoxy exemplified by the legends about the foundation of two shrines: St. George Monastery near the Cape Fiolent, Crimea and the Panagia Tripiti Church in Aigion, Peloponnese. It is argued that the similar interpretation of EQL observation in the Crimean and Peloponnesian legends were caused by similar natural and economic living conditions of the Greek population in the both regions in the Middle Ages. We also consider some examples of EQL observation took place in other regions and their interpretation in other denominations. Differences and relations between EQL of mechanoelectrical and degassing origin are discussed. Finally, we consider the role of active faults in the production of a mystical experience and sacralization of an affected landscape (Florinsky 2016, 159).
>
> Mystical experience is a sort of altered state of consciousness characterized by visual and auditory hallucinations, including apparent contacts with divine or supernatural creatures. These contacts are often accompanied by extreme emotions, such as delight, euphoria, horror, panic, etc. (Florinsky 2016, 160).

While the mystery of the pyramids has attracted millions of visitors over the years and is promoted not only by New Age groups but also by leading minds in Egyptology, removing the mystery and providing a solid foundation of understanding based on physics and science can only attract more. The energies of the Earth will continue to be amplified in the Great Pyramid regardless of what we may believe about their nature. Tour operators will continue to promote their tours to draw visitors who are attracted to esoteric, occult, and seemingly magical experiences. Some do, or will, believe that the purpose for building the pyramids was to provide those who enter them a place where a deeper connection to the consciousness of the universe may be felt and may refer to them as initiation chambers.* But those who have not visited the pyramids and have not enjoyed that experience, when understanding that there is an explanation based on physics and science, will be able to understand that it's not all due to an overactive imagination or "in the head" of the human being affected but that the source for this stimulation is in the Earth and in the pyramid itself.

Am I goring a sacred cow? Some may argue that I am and choose to ignore what decades of dedicated research by qualified physicists like Friedemann Freund have produced. Regardless of what I think and write here, nobody can predict how they will be affected while being inside the Great Pyramid or whether a companion who joins them in the King's Chamber will experience the same effect. Maybe they will not be affected at all. After visiting Egypt 14 times, I have learned that being moved by an unusual experience inside the Great Pyramid during one visit does not mean that the next visit will give me the same experience. This, I believe, is because of fluctuation in the Earth's activities causing a higher level of seismic activity on one visit rather than another. I also wonder whether the time of the year that you visit affects these fluctuations.

Just the concept of an energy source that is environmentally friendly and is in harmony with nature is inspiring in and of itself without needing to enter the Great Pyramid. Becoming inspired and elated is probably not the experience we would anticipate having when exploring the energy center of a defunct, abandoned, and decaying modern power plant.

Wanting to know how my Facebook friends who have visited the Great Pyramid were affected within its confines, I asked for feedback. Some

preferred to share privately, while others publicly gave detailed accounts of their experience. A few of their responses were:

- Feeling as though they were inside a powerful machine.
- Started to get light-headed, then while sitting felt like there was a ball of energy above me.
- Had a miraculous healing experience in the Subterranean Chamber.
- Had a miraculous healing experience in the King's Chamber.
- In the coffer and intoning I felt as though my voice was powering a huge subwoofer and felt like I was lifting out of my body.
- I was there alone and felt a strong presence.

One of the responders to my question answered privately because they did not want to publicly share. I understand that because, historically, many have had what they thought were supernatural experiences but don't talk about them for fear of being ridiculed. One of my friends shared the following in a private message:

> Just wanted to tell you about my experience in the King's Chamber. I was in it when we started doing the chants . . . the resonance was shaking me and was actually frightening. If I tried to join in, the resonance was so loud I couldn't continue.
>
> I tried to relax and catch my breath, and suddenly the lights all went out. The blackness was something I'd never experienced before, it was quiet and calm and I was finally feeling calm and I seemed to see lights before my eyes. They were still there whether my eyes were open or not. It was very serene once I relaxed but there was definitely some energy entering my body.
>
> I'm not a real spiritual person but it was quite profound and will stay with me forever. I felt like I was connecting to something powerful.
>
> I spent about 15 minutes in "the box"* quite an experience.

Napoleon Bonaparte is probably the most famous person in history who is reported to have exited the pyramid a bit shaken up but closemouthed about what he experienced inside. However, this legend might be just a myth with no accurate records to support it. In "Napoleon at the Pyramids:

Myth Versus Fact," historical fiction writer Shannon Selin provides reason to question this hoary legend. She writes:

> The third myth appears to be of more recent vintage. Napoleon is said to have spent some time alone in the Great Pyramid, from which he emerged visibly shaken by some experience that he refused to divulge to anyone else.

Napoleon Stayed Outside

> The problem with these legends is that no one who was with Napoleon in Egypt reports that he ever entered a pyramid. According to Napoleon's private secretary, Bourrienne:
>
> "On the 14th of July Bonaparte left Cairo for the pyramids. He intended spending three or four days in examining the ruins of the ancient Necropolis of Memphis; but he was suddenly obliged to alter his plan. This journey to the pyramids, occasioned by the course of war, has given an opportunity for the invention of a little piece of romance. Some ingenious people have related that Bonaparte gave audiences to the mufti and ulemas, and that, on entering one of the great pyramids he cried out, 'Glory to Allah! God only is God, and Mahomet is his prophet!' Now, the fact is, that Bonaparte never even entered the great pyramid. He never had any thought of entering it. I certainly should have accompanied him had he done so, for I never quitted his side a single moment in the desert. He caused some persons to enter into one of the great pyramids while he remained outside, and received from them, on their return, an account of what they had seen. In other words, they informed him there was nothing to be seen" (de Bourrienne 18381, 208; Selin 2017).

I'm not sure how the Napoleon rumor began, when it began, or who started it, but it has been reported quite convincingly by many, including Tompkins, who wrote:

> Meanwhile Napoleon, whose logistical mind enabled him to figure that the Great Pyramid and its Giza neighbors contained enough

> stone to build a wall 3 meters high and one meter thick all around France, had become attracted by the arcane qualities of the King's Chamber.
>
> On the twenty-fifth of Thermidor (the Revolutionaries' August 12, 1799) the General-in-Chief visited the Pyramid with the Imam Muhammed as his guide; at a certain point Bonaparte asked to be left alone in the King's Chamber, as Alexander the Great was reported to have done before him. Coming out, the general is said to have been very pale and impressed. When an aide asked him in a jocular tone if he had witnessed anything mysterious, Bonaparte replied abruptly that he had no comment, adding in a gentler voice that he never wanted the incident mentioned again.
>
> Many years later, when he was emperor, Napoleon continued to refuse to speak of this strange occurrence in presage of his destiny. At St. Helena, just before the end, he seems to have been on the point of confiding to Las Cases, but instead shook his head saying, "No. What's the use. You'd never believe me" (Tompkins 1971, 49–50). (Note: Tompkins provides no in-text footnotes or citations.)

It appears that, according to Tompkins, Napoleon was just as concerned about the reaction to his sharing what he had experienced inside the Great Pyramid as my Facebook friend. But Napoleon's, my friend's, and my own shared accounts of the unusual effects that are experienced by so many people who enter this energy machine do not count as evidence to support the arguments put forth in this book. These anecdotes, while interesting, are separate from the scientific and experimental reports that have been performed.

Comparing the cultural differences in society today with those of 100 years ago, there is no doubt that human interactions with technological advances have significantly affected how we live, work, and play. Those born today grow up surrounded with symbols of progress, from the architecture that fills major cities to the houses they live in and the transportation they use to get from one place to another. With these influences around them, they connect with a utility that allows them, in Star Trek fashion, to reach across the world and talk by videophone to people they know personally and those they have just met virtually. In writing this book, I have benefitted from the ability to ask a question of a friend in

Egypt and receive a response in less than an hour. If I suddenly lost that ability, I would have to adjust, but I would probably adjust more peacefully than someone who has never experienced the world before these technologies became available.

> *I don't think there is such a thing as a real prophet. You can never predict the future. We know why now, of course; chaos theory, which I got very interested in, shows you can never predict the future.*
>
> ARTHUR C. CLARKE (CLARKE 1968)

Because we were not born into an environment in which the pyramids functioned as electron harvesters with associated technologies, engendering a culture that was influenced by and reacted to these technologies, we can only ask: What did that civilization look like? How did the people live? What abilities did they possess—their own natural abilities and those connected with and facilitated by the technologies in their possession? We can imagine, but in truth, our imaginations will most likely fail us.

A case in point is the introduction of robots in the manufacturing workplace. In the 1970s, computers were becoming more powerful, and manufacturing machines were modified to operate automatically. One article I read in a trade magazine in the '70s contained a prediction that robots would eventually replace highly skilled machinists and toolmakers, which, along with other reasons, resulted in young people being guided into different careers because of a perceived redundancy in the future. The article discussing these developments included a graphic that showed a human-like robot operating a manual lathe. In much the same way as a human does, the robot's hands were gripping and turning the wheels that caused movement of the lathe's axes. The concept the writer had of how robots would replace machinists in the future, it turns out, could not be further from the truth. The technology built into the robot that allowed it to stand on its robot legs, pressing buttons, flipping handles, and turning wheels with its robot hands, was installed in the lathe itself. Such are the limits we possess in accurately predicting how new technologies will change our environment at work or at home.

The great classical master composers, I believe, were accessing information in the universe that is profoundly unique and beyond the reach

of normal people. Perhaps they were drawing from the same source described by Tesla as "the core." I ask the question: "What was going on in their brains when they were creating such masterpieces?" What was their dream state like? It is as though a section of the universe opened up and spilled into their consciousness the beauty of heaven in the form of an organized, disciplined order of musical notes. Did they visualize this order as it played in their heads prior to being set down on paper? Did they hear it? How can you describe something you have had no previous experience with? We get to experience and enjoy the results of a process that remains a closed book.

With the testimony of many visitors to the Giza Plateau who speak of what has been described as a supernatural experience within and around the Great Pyramid, a reasonable framework based on physics provides us with an understanding that natural forces, rather than supernatural magical sources, are at work there, which again brings us back to the famous quote by Arthur C. Clarke: "*Any sufficiently advanced technology is indistinguishable from magic*."

In the case of the Great Pyramid Electron Harvester, those powerful pulses that were crunching igneous rock and providing unimaginable benefits to the society that built it are now pulsing quietly and causing *hum*ans to hum.

---

*The actual source of this quote is unknown. It fits many of Einstein's ideas but is not found verbatim in any of his works, despite frequent attribution.

*With its prolific terrestrial light shows, Marfa, Texas might also yield a bumper crop of electrons.

*These effects are discussed in *Awakening the Planetary Mind* by Barbara Hand Clow. (Clow 2011, 83–88)

*King's Chamber granite sarcophagus.

FOUR

THE KING'S ORCHESTRA

THE MUSIC OF THE PYRAMIDS

Deep inside the beating heart of a mountain of stone is a finely tuned musical instrument that was designed to draw into its space acoustic energy from other finely tuned instruments that were balanced and positioned precisely in a row, ready to convert mechanical vibrations into airborne sound. Manufactured and assembled with machine-like precision, the King's Chamber and Grand Gallery orchestra worked in unison and harmony, and while most of the public's attention for the past 20-plus years has been focused on the Queen's Chamber and what lies at the end of an 8 inch (20.32 cm) square shaft, the musical ensemble above it is infinitely more magnificent, more complex in design and construction, and, from a purely scientific and engineering perspective, sufficiently advanced technologically that many who have experienced being within its space have left with the feeling that they were in the presence of something supernatural. As if they were surrounded by magic.

Although they perform different functions as parts of this electron harvester, the King's Chamber and Grand Gallery cannot be addressed separately without one recognizing the other. Little happens in the King's Chamber without the Grand Gallery functioning as it was designed, and without the King's Chamber, the Grand Gallery is unnecessary.

If one considers the Great Pyramid to be a tomb, it would be reasonable to ask why this supposed resting place for a king would have most of its parts hidden from view? Didn't the king deserve to appreciate the work that had been done on his behalf? The first person to penetrate the barriers that prevented all those who had entered the pyramid before him from beholding

the enormous labor and fortune was the British Colonel Richard William Howard-Vyse. In 1836, thousands of years following this extraordinary expenditure of time and labor, Howard-Vyse, while conducting explorations in the Great Pyramid, was in a crouched space above the King's Chamber, examining a mysterious layer of granite beams above him that were similar to the granite beams that formed the ceiling of the King's Chamber beneath him. The space is named "Davison's Chamber" after Nathaniel Davison, who had discovered it in 1765.

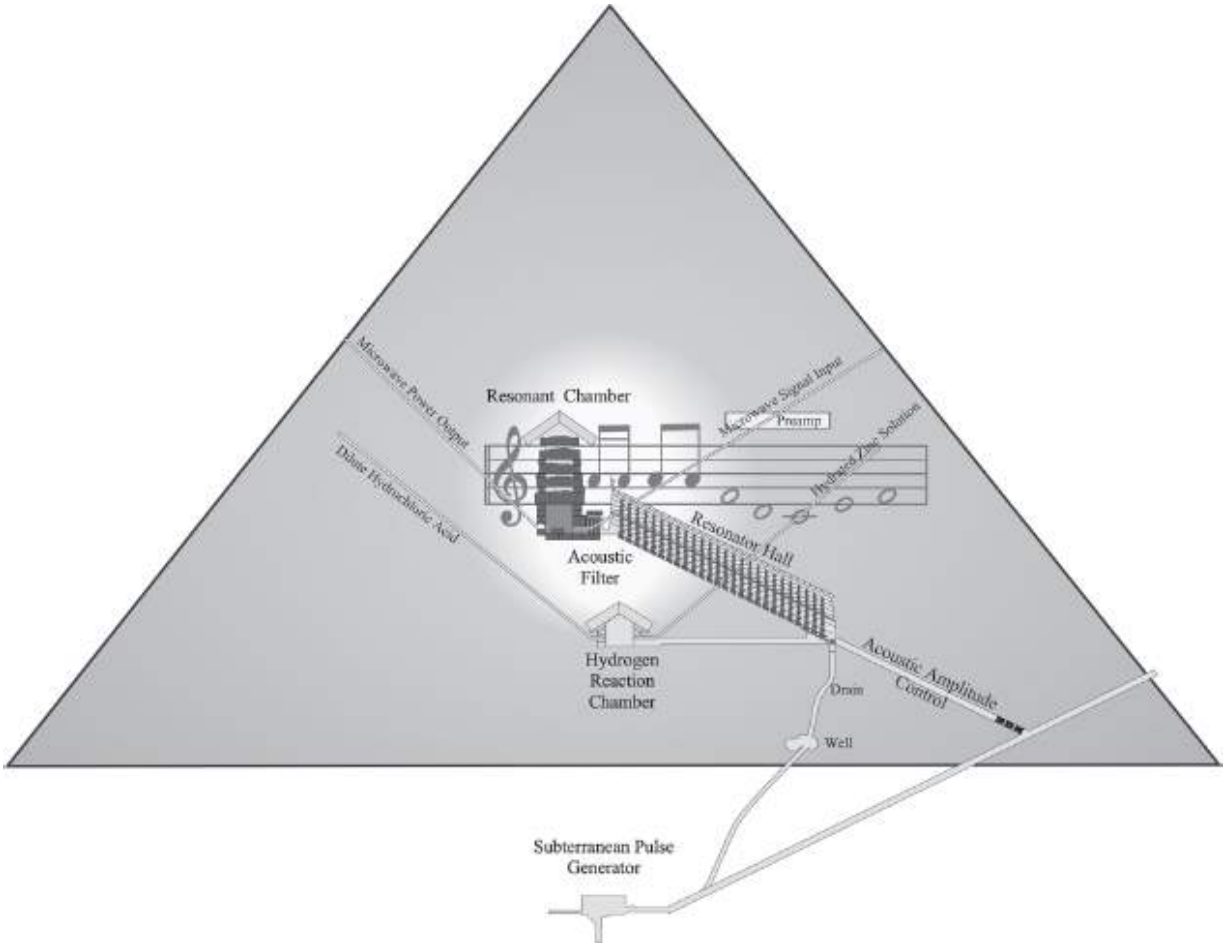

Figure 4.1. The King's Chamber and orchestra. (See also color plate 9.)

Howard-Vyse, who had received £10,000 from his family to conduct this exploration and, reportedly, relieve themselves from his presence, was intent on making a significant discovery and, so far, was not having any luck. The granite layer above his head posed a tantalizing clue that

something might lie beyond. Noticing a crack between the beams, Howard-Vyse considered the possibility of yet another chamber above. Being able to push a three-foot-long reed into the crack without obstruction seemed a clear indication that there must be another space beyond.

Abandoning the slow and tedious results that hammers and chisels produced, and armed with a supply of gunpowder and hashish, Howard-Vyse recruited one of his workers to risk life and limb by setting charges and scurrying off while limestone and granite were blasted away and showered down the vertical shaft that was slowly inching its way up above the King's Chamber until another chamber was revealed.

Similar to Davison's Chamber, a ceiling of monolithic granite beams spanned the newly discovered chamber, indicating to Howard-Vyse the possible existence of yet another chamber above. After blasting upward for three-and-a-half months and to a height of 40 feet (12.19 m), they discovered three more chambers, making a total of five. To construct these five chambers, the ancient Egyptians found it necessary to use 43 pieces of granite weighing up to 70 tons each. The red granite beams are cut square and parallel on three sides but were left seemingly untouched on the top surface, which was rough and uneven. Some of them even had holes gouged into their top sides.

KHUFU'S CARTOUCHE

When Howard-Vyse's team blasted through to reveal the uppermost chamber, they discovered that it was fitted with massive gabled limestone blocks, one of which was adorned with a cartouche that contained within it the name of Khufu. There has been quite a bit of controversy surrounding the validity of these markings, with some conspiracy theorists claiming that Howard-Vyse himself had painted them so he could claim a major discovery. Are they original to the time the pyramid was built, or were they added later? I have been asked my opinion of them on several occasions over the years, and while I do not take sides on who is correct in the debate about the origins of the markings, my opinion has always been that they are graffiti, whether they were painted when the pyramid was built, or later, when Howard-Vyse discovered them. From an engineering perspective, graffiti is irrelevant when trying to understand the design and function of an engineered product. An example would be the graffiti painted on the side of

a railroad car has nothing to do with the purpose for which the railroad car was built. Having said that, I recognize that to historians these marks may have value and may stimulate a much wider and deeper investigation regarding their origins that doesn't involve engineering.

Along that same line of thinking, young people today may recognize the name Tesla as being a manufacturer of electric automobiles. They may learn, after being told this, that Tesla was a genius who died 80 years ago after ushering in the electrical age by inventing alternating current (AC) transmission. There is no question that the car maker and the man have no connection, other than an honorary recognition of the man's pioneering efforts by the modern electric car manufacturer. In our small window of time in the life of the planet, there is no mistaking the application of the name Tesla on products with the actual human. Can we say the same for humans in the future? Living as we are within this time frame, this span of time is significant. When considering prehistory and the age and purpose of what was created thousands of years ago, a hundred years is a mere sliver on the time chart.

Considering the enormous effort that must have gone into delivering to the Giza Plateau the granite monoliths above which these inscribed gabled blocks are situated, it's natural to wonder why all this work was necessary? By today's standards, the task of quarrying just one of the granite beams at the Aswan quarries and transporting it 500 miles down the Nile to the Giza Plateau before raising it approximately 200 feet (60.96 m) in the center of the pyramid would not be a simple or inexpensive task. That this step was repeated 43 times surely gives us a hint that these monoliths are not just construction materials, even though, to the ancient Egyptians, these monoliths are a fraction of the size of other monoliths that had been and were in the process of being extracted from the quarry. The ancient Egyptians didn't seem to be daunted by what was necessary to create obelisks and statues that weighed in excess of 1,000 tons out of hard, igneous rock.

If Howard-Vyse had contained his enthusiasm within the limits of modern archaeological methods and standards, chances are we would not know that these enigmatic chambers exist. But we do, and we have him to thank for it. However, they need to be explained in a reasonable and scientific way. Howard-Vyse surmised that the reason for the five superimposed chambers was to relieve the flat ceiling of the King's

Chamber from the weight of thousands of tons of masonry above and allow it to have a flat ceiling, rather than a gabled ceiling similar to the ceiling in the Queen's Chamber. This explanation seemed to have stuck and is repeated in mainstream literature. However, as I argued in *The Giza Power Plant*, the 43 giant granite beams that spanned 27 feet (8.23 m) in length and weighed up to 70 tons are holding up no more than their own weight, and the structures responsible for holding up the blocks of the pyramid above are the limestone gable blocks in the uppermost chamber. I argued that the Queen's Chamber could have been fitted with a flat ceiling without the multiple layers of beams above. I thought my reasoning was logical and didn't expect any opposing argument.

I was wrong. The internet and social media can always produce an opposing argument for anything in the world. As you can imagine, arguments against the Giza power plant theory have been prolific and creative. One such argument against my assertion that the five layers of granite beams above the King's Chamber were redundant came to my inbox by way of South African Egyptology student Mikey Brass, who alerted me to an article that had appeared in a German magazine the year following the publication of my book, where the question was discussed with researcher Frank Dörnenburg. Dörnenburg writes:

> I have been debating elsewhere, the King's Chamber and the question of why five "relieving" Chambers were needed to be used to spread the massive weight above the King's Chamber. My answer to this was I simply did not know.
>
> A good answer to this question can be found in Göttinger Miszellen 173/1999, p 139 ff: Ludwig, Daniela; Offene Fragastellungen in Zusammenhang mit der Cheopspyramide in Giza aus baukonstruktiver Sicht.
>
> "The old method of corbeling channeled the weight force directly to the walls of the chamber. The new, and here for the first time used, gable-roof redirects the force down AND sideways. If the Egyptians had put the gable roof in the King's Chamber directly on the ceiling, like in the Queen's Chamber, the sideways force would have damaged the Great Gallery. So they had to put the gable above the upper layer of the Galleries construction. The easiest way to do this is to stack small chambers. And if you look at the cross section

you will see, that now the sideways force of the roof goes well over the roof of the gallery."

Superficially, what is proposed here may seem plausible. It is, however, a construct founded on flawed assumptions and an incomplete analysis of the entire King's Chamber complex. Consider the following.

The hypothesis assumes that dynamic lateral forces would follow the direction of the angled blocks and that these lateral forces would accumulate as more stone was piled on top of the gabled bocks. According to the hypothesis, the consequence of each block added above the King's Chamber causes additional lateral thrust to push against the southern end of the Grand Gallery.

The drawing in Figure 4.2 represents a mechanical setup with which many manufacturing technologists would be familiar. It is a steel plate resting in a V-block. If we allow that the above hypothesis is correct, the plate will push on surface A, causing lateral movement.

Such is not the case. At rest, the plate will put more pressure on the opposite surface B, due to the center of gravity of the piece. There are no dynamic forces at work. There is only dead weight, which is distributed according to each member's center of gravity. When an object is placed on an inclined plane, it has the potential to move down that plane by gravitational forces acting upon it. This movement continues until an obstruction is encountered, at which time the lateral motion ceases.

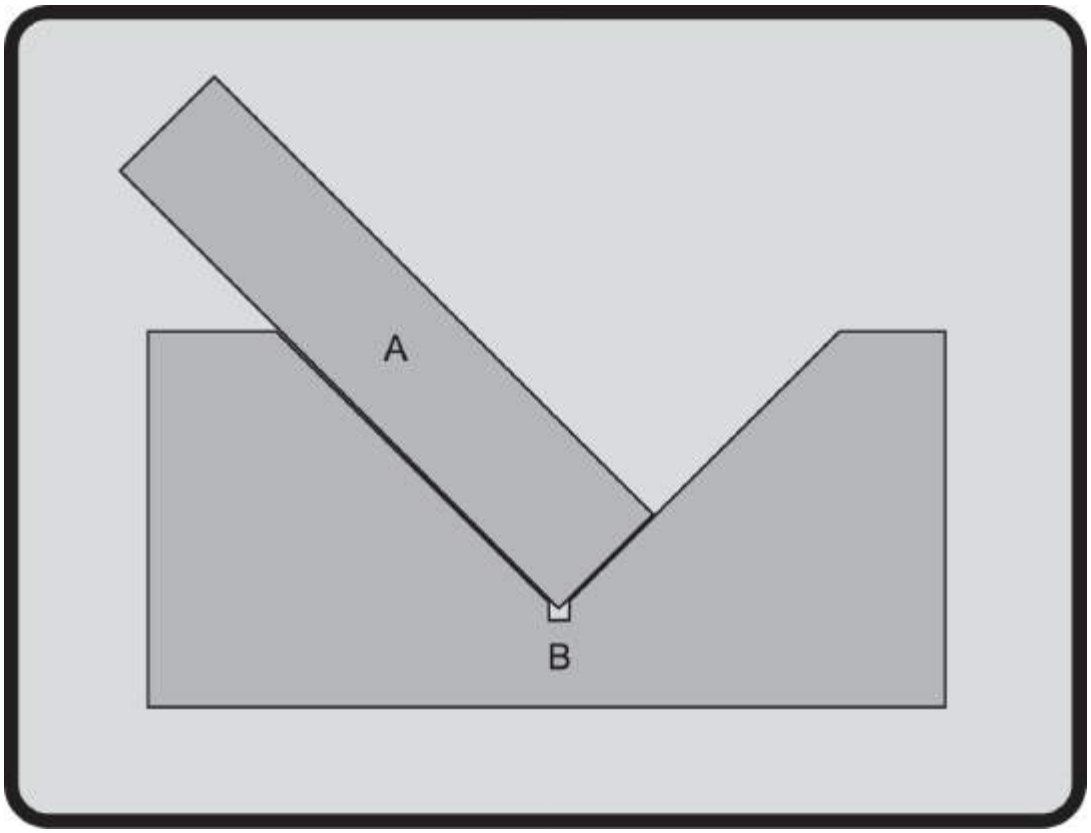

Figure 4.2. V-block holding rectangular plate.

The gabled ceiling blocks above the King's Chamber are situated on an inclined plane cut into the core blocks. Assuming that, like the Queen's Chamber, the center of gravity of these blocks lies outside the chamber walls, the blocks may be described as cantilevered, whereas there is no arch thrust at the apex where two opposing blocks meet. The entire weight of the block is borne by the core masonry blocks that have an inclined plane upon which the gable block sits, with some weight being carried by the block that captures the lower end.

With the Grand Gallery's southern wall blocks butted against its east and west wall blocks, any lateral forces from the King's Chamber's gabled ceiling blocks give less cause for concern than, say, the forces acting on the roof of the Horizontal Passage from the pressure of the Queen's Chamber's gabled ceiling blocks or the pressure of the blocks bearing down on the roof of the Grand Gallery. Moreover, building on top of gabled ceiling blocks does not necessarily mean they must bear a tremendous accumulation of weight. As described in Figure 4.3, the distribution of weight does not

necessarily have to bear down on the gable. A core masonry block can be sized and placed so that the gable blocks have little to no weight on them at all.

Without knowing for sure what design features were employed, I can envision a sound design that would not damage the Grand Gallery.

The argument that the builders were directing the lateral forces of the gable blocks away from the Grand Gallery to protect it from movement is based on a drawing of the King's Chamber and Grand Gallery looking from east to west. But when the King's Chamber and Grand Gallery is viewed from north to south, the argument dramatically falls apart. A precise arrangement of large multiton blocks can ensure that their weight will be directed vertically and will not impact the Grand Gallery or place undue pressure on the King's Chamber's gabled blocks. Figure 4.3 illustrates the Grand Gallery's indifference to the King's Chamber's gabled blocks, should they be used to cover just the ceiling of the King's Chamber.

When seen from north to south, it becomes clear that structurally, the assembly of monolithic granite beams above the King's Chamber, with the protective gabled limestone above, has no influence on the Grand Gallery. The top of the Grand Gallery is only 42 inches (1.07 m) wide, while the widest point at the bottom is 82 inches (2.08 m). The King's Chamber is just over 34 feet (10.36 m) long—over nine times the width of the top of the Grand Gallery next to the ceiling. Even if we accept that there would be undue pressure on the south wall of the Grand Gallery, which I don't, it would not necessitate five layers being built across the entire length of the King's Chamber. Also, why five layers of beams? Why not a large open space with the gabled ceiling above?

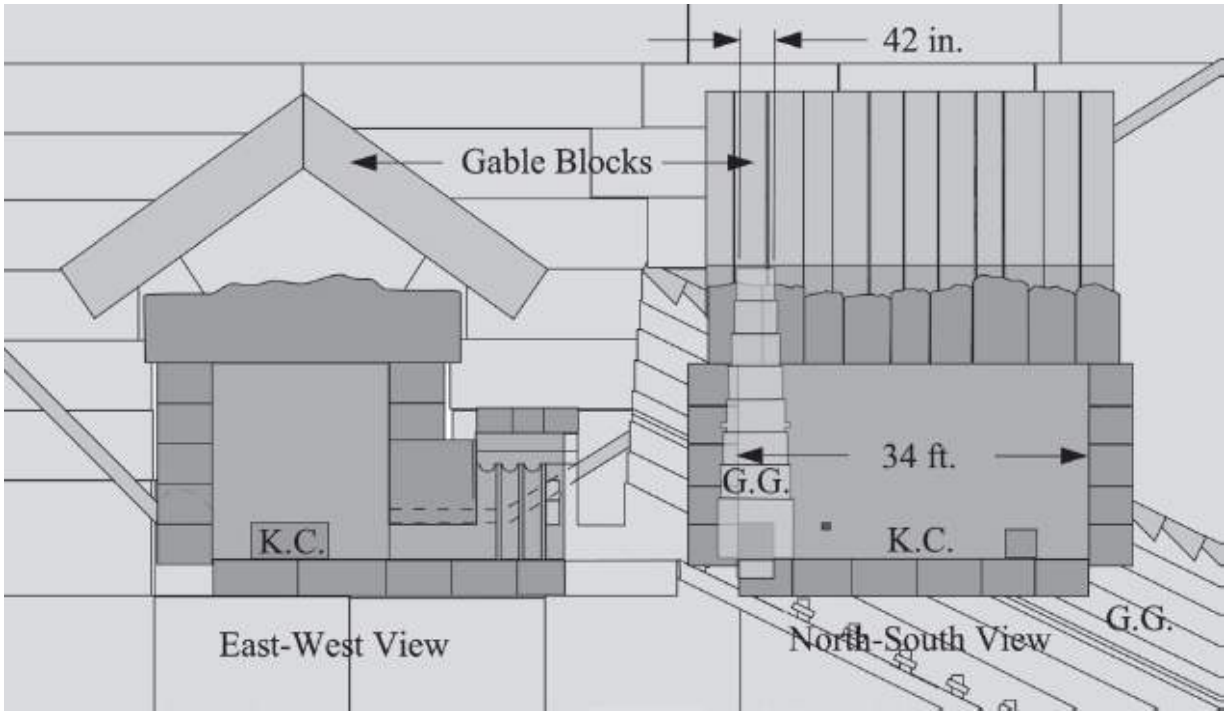

Figure 4.3. East-west and north-south view of King's Chamber.

In cutting these giant monoliths, the builder evidently found it necessary to craft the beams destined for the uppermost chamber with the same precision and finish as those directly covering the King's Chamber. Each beam was cut flat and square on three sides, with the top side seemingly untouched. This is significant, considering that the beams directly above the King's Chamber would be the only ones visible to those entering the pyramid.

The rough measurement between the ends of the gabled blocks and the Grand Gallery south wall is about 9 feet (2.74 m). Considering the width of the Gallery (between 42 and 82 inches [1.07–2.08 m]), it is reasonable to assume that the blocks forming the gallery's south wall extend to the east and west outside the inner surface. The conventional argument for the so-called Relieving Chambers does not provide any relief when searching for the truth.

KING'S AND QUEEN'S CHAMBERS NORTH SHAFT TRICKERY

More evidence inside the Great Pyramid that escaped my attention when I wrote *The Giza Power Plant* was the location and design of the King's and Queen's Chamber North Shafts. It is generally accepted that these shafts change direction to avoid interference with the Grand Gallery as they get closer to it. As recorded by earlier explorers and illustrated in great detail by Rudolf Gantenbrink, the King's Chamber North Shaft, like the Queen's Chamber North Shaft, contains several bends, which allows a greater distance between the shaft and the Grand Gallery. That is a reasonable assumption and one I tend to agree with. However, the question is, by how much does the shaft need to stay clear of the gallery?

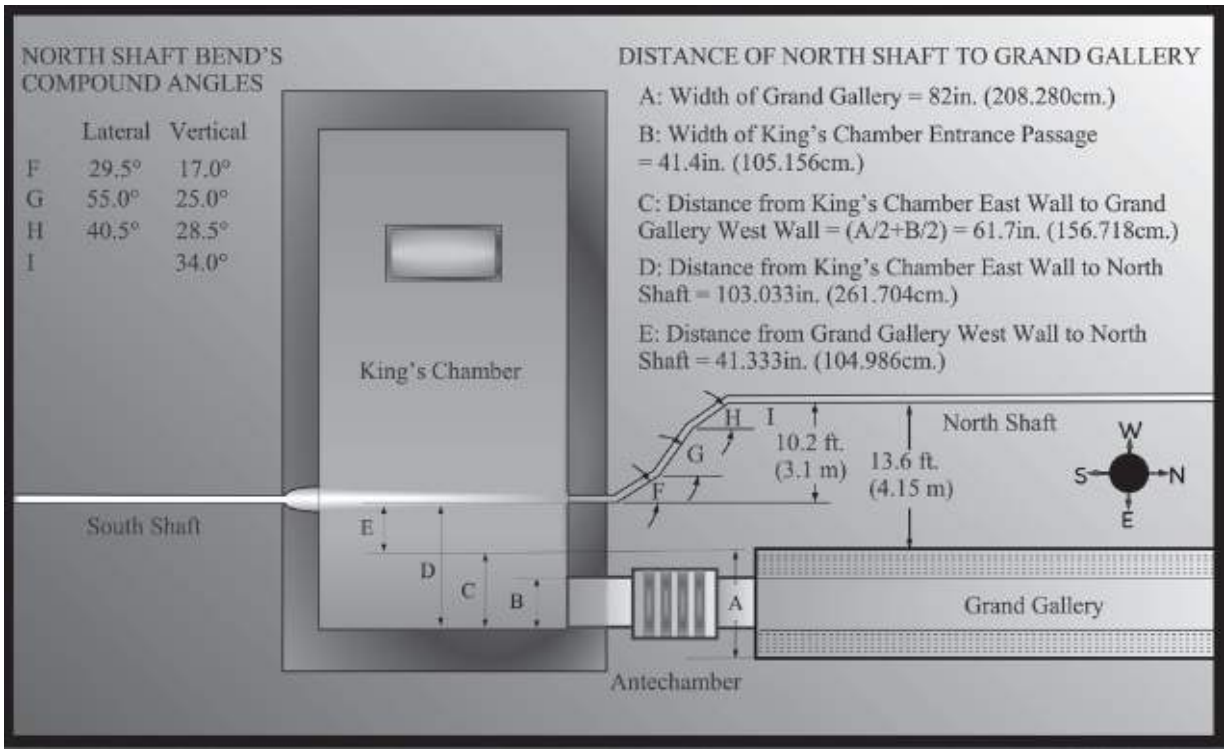
NORTH SHAFT BEND'S COMPOUND ANGLES
Lateral Vertical
F 29.5° 17.0°
G 55.0° 25.0°
H 40.5° 28.5°
I 34.0°
DISTANCE OF NORTH SHAFT TO GRAND GALLERY
A: Width of Grand Gallery = 82in. (208.280cm.)
B: Width of King's Chamber Entrance Passage = 41.4in. (105.156cm.)
C: Distance from King's Chamber East Wall to Grand Gallery West Wall = (A/2+B/2) = 61.7in. (156.718cm.)
D: Distance from King's Chamber East Wall to North Shaft = 103.033in. (261.704cm.)
E: Distance from Grand Gallery West Wall to North Shaft = 41.333in. (104.986cm.)
King's Chamber
South Shaft
North Shaft
10.2 ft. (3.1 m)
13.6 ft. (4.15 m)
W
S
N
E
Grand Gallery
Antechamber

Figure 4.4. Plan view of King's Chamber, Grand Gallery, and North Shaft. (See also color plate 10.)

What is really mind-blowing and worth remembering is that both the King's and Queen's Chamber North Shafts *could have been* constructed, like their South Shafts, without bends, because they are located 3.4 feet (1.04 m) from the Grand Gallery's west wall. I overlooked that detail when I wrote *The Giza Power Plant*, but the extra difficulty the builders undertook to guide the shaft further than 3.4 feet away from the Grand

Gallery's inside wall is a significant detail that cannot be ignored, and it contributes to the overall picture of the extraordinary effort expended by the builders and how they did not do anything by chance or on a whim. See Figure 4.4 and color plate 10 for the measurements and angles of the shafts.

Considering that the King's Chamber North Shaft bends around the Grand Gallery strongly suggests the blocks that form the gallery walls had to be thicker than 3.4 feet (1.04 m). Why do the Grand Gallery wall blocks need to be thicker than 3.4 feet (1.04 m)? In the context of the electron harvester theory, there is a logical answer to this question. Like the King's Chamber, the Grand Gallery does not rely on the surrounding core masonry for its structural integrity, with the exception of the masonry underneath that is holding it up. This is because its function relies on greater stability and precision than the core masonry that surrounds it. It is built to withstand continuous vibration generated in the Subterranean Chamber. However, unlike Tesla's apartment building that was threatening to shake apart from the harmonic forces imparted by his earthquake machine, the Grand Gallery did what it was designed to do: pass the vibrations through to resonators suspended at intervals along its length and convert them to airborne sound. The movement of that sound relies on fixed and precise dimensions.

NOT TRICKERY—PHYSICS AND ENGINEERING

While the question of why the North Shafts need to be a substantial distance away from the Grand Gallery is being considered, a more important and fundamental question has been overlooked—and was missed by me when I wrote *The Giza Power Plant*. The question is, why do the shafts need to be at this exact location? If they were air shafts, or shafts through which the King's soul would pass, surely the openings could be anywhere in the chamber—further to the west, east, closer to the ceiling or the floor? But they are not, and considering the extra work involved in placing them in that specific location, there has to be a good reason for it.

The answer to this question is critically related to the function of the pyramid machine. As Dustin Carr, PhD, first pointed out to me, and Robert Vawter and Eric Wilson later confirmed, these shafts appear one quarter of the distance along the length of the chamber.

This is significant, for that location is where the highest amplitude (energy) exists in a standing wave in a resonant cavity. Moreover, it is

where the input of energy will have the most effect.

Figure 4.5 is an isometric view of the King's Chamber North Shaft and its relationship with the King's Chamber and Grand Gallery. The three-dimensional geometry was collected by Rudolf Gantenbrink and was once available for viewing through a CAD viewer on his website, Cheops. The website is now archived and available at the UPUAUT Project page on the ISIDA Project's website. Gantenbrink's excellent work allows us to visualize these shafts more clearly and punctuate the points that follow:

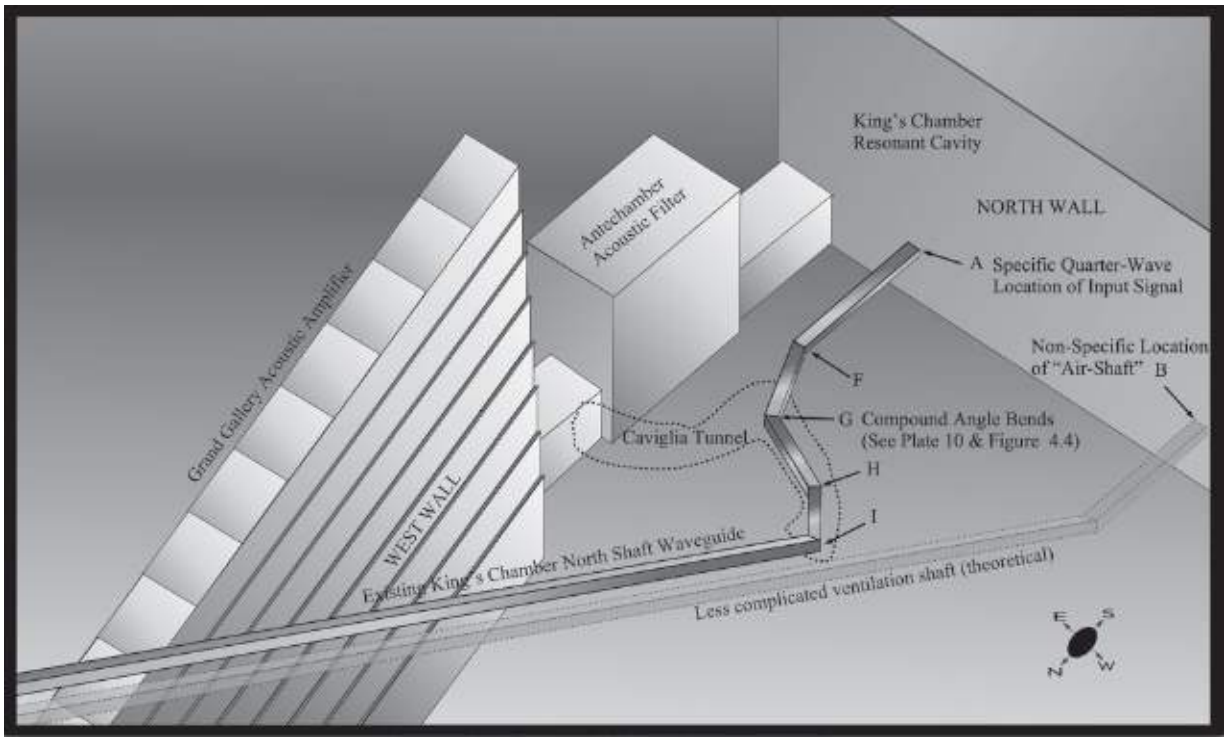

Figure 4.5. Isometric view of King's Chamber, Grand Gallery, and North Shaft. (See also color plate 11.)

- Shaft A is the existing shaft, which has multiple lateral bends that redirect it to/from the quarter-wave location in the King's Chamber. These redirections occur three-dimensionally and the vertical angle decreases with each turn (see Figure 4.4).
- Shaft A could redirect with just two bends. But it has four. Why?
- Shaft B is a theoretical air shaft that only has one bend.

If the purpose of these shafts was to ventilate the chambers, a simple, straight, horizontal shaft would suffice.

CAVIGLIA'S TUNNEL

Caviglia's tunnel, as illustrated in Figure 4.5, was excavated in the mid-1830s by Giovanni Battista Caviglia, who was hired by Colonel Richard William Howard-Vyse to join him in blasting through areas of the Great Pyramid in his hunt for treasure. The entrance, which is fitted with an iron gate and normally padlocked, is located in the short horizontal passage between the Grand Gallery and the Antechamber. During one of my many visits, I noticed the padlock had been removed, so I entered the tunnel and made my way to the North Shaft. It was just a brief visit while using a rather dim flashlight, but I was able to notice that the upper section of the shaft was left exposed up to where Gantenbrink had installed a ventilation fan.

WEIGHING THE EVIDENCE

There is only one published theory that provides answers to the questions raised by the existence of the King's Chamber North Shaft. This was published in *The Giza Power Plant:*

> The North Shaft served as a waveguide through which the input microwave signal traveled. A typical waveguide is rectangular in shape, with its width being the wavelength of microwave energy and its height measuring approximately half its width. The North Shaft waveguide was constructed precisely to pass through the masonry from the north face of the pyramid and into the King's Chamber. That microwave signal could have been collected off the outer surface of the Great Pyramid and directed into the waveguide.
>
> The (originally smooth) surfaces on the outside of the Great Pyramid are dish-shaped and may have been treated to serve as a collector of radio waves in the microwave region that are constantly bombarding the Earth from the universe. Amazingly, this waveguide leading to the chamber has dimensions that closely approximate the wavelength of microwave energy 1,420,405,751.786 hertz (cycles

per second). This is the frequency of energy emitted by atomic hydrogen in the universe. (Dunn 1998, 185–186)

The wavelength of hydrogen is 8.309 inches. The width of the King's Chamber North Shaft is 8.4 inches.

Now, after examining the shaft's details more closely and considering the newly discovered Big Void as well as the advice of a brilliant physicist and aerospace engineer, we can add more evidence to the list that was published in *The Giza Power Plant*. See color plates 12 and 13.

- North Shaft dimensions approximate those necessary for the design of a waveguide.
- The South Shaft has a bulbous opening that is similar to a microwave horn antenna.
- Extra care and knowledge were necessary to include bends in the North Shaft so that it entered the chamber at the exact quarter-wave location.
- Instead of a two-bend transition to reach the quarter-wave point, the North Shaft has four. While the design of waveguides is a specialty, with craftsmen carefully tuning them using various means, Eric Wilson was not surprised to see four bends instead of two, for, as he explained to me, they would facilitate the direction and power of the beam.
- Wilson, who had studied Gantenbrink's CAD drawings very closely, also noted that transition points were included along the upper length of the shaft. A channel block further up the shaft, which is longer than the others, is seen to have a radial protrusion in the ceiling, while another area close to the bottom transitions from a larger height to a smaller one. These features, he said, are not uncommon when designing and building an extremely long waveguide, which can be something of a "black art" that requires unique skills and knowledge.
- We also cannot forget the potential relationship of the North Shaft with the recently discovered Big Void, which, like the North Shaft, appears to be located to the west of the Grand Gallery halfway between two anomalies that are noted above and also shown in Figure 4.6. Whether this observation is significant is yet to be determined. Further research promises to be more accurate in its results.

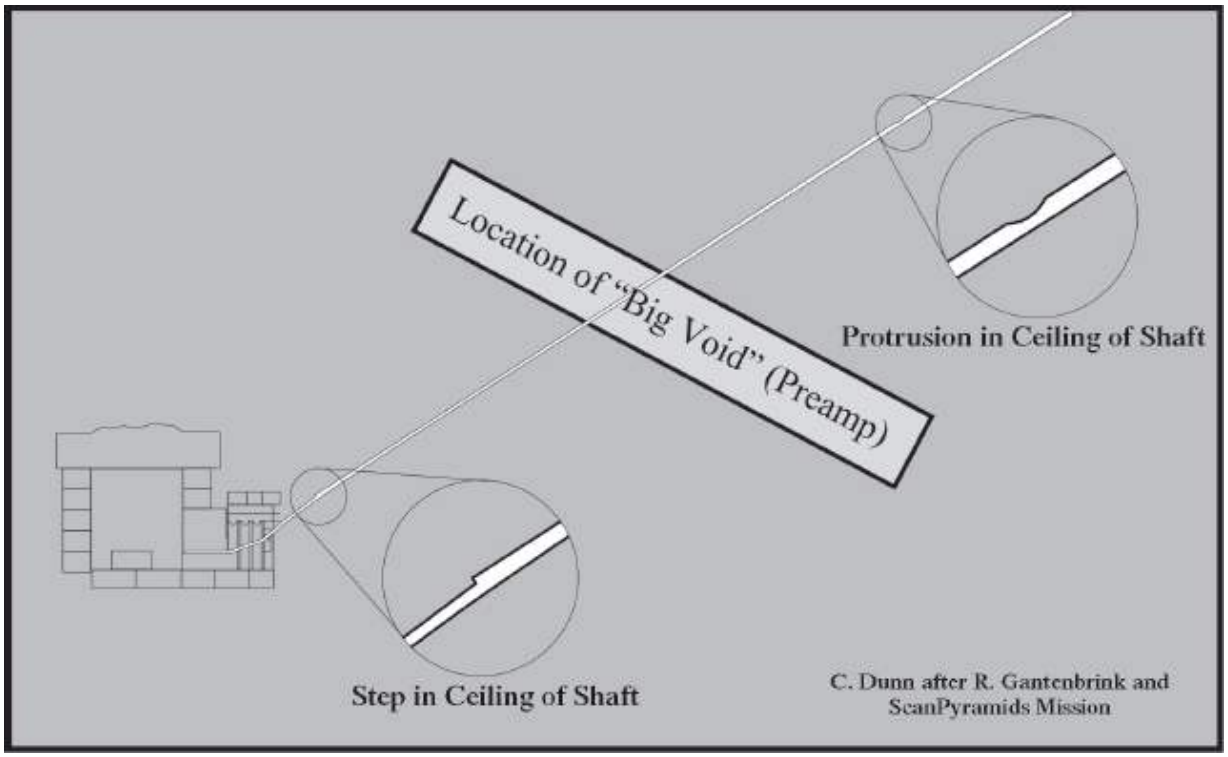
Location of "Big Void" (Preamp)
Protrusion in Ceiling of Shaft
Step in Ceiling of Shaft
C. Dunn after R. Gantenbrink and ScanPyramids Mission

Figure 4.6. Anomalous feature in the North Shaft.

There doesn't appear to be any reason other than a waveguide for the King's Chamber North Shaft to exist. It's a highly technical and complicated inclusion in the pyramid that required skill and precision to assemble. It cannot be dismissed lightly or assigned a mundane nontechnical function.

WHEN THE EARTH SHOOK

When the Grand Gallery was built and its resonators assembled inside, it functioned as designed without relying on frequent maintenance or tuning.

Other features and what can be described as mysteries exist within the King's Chamber and Grand Gallery. Many of them found potential explanations in *The Giza Power Plant*. One explanation related to Sir William Flinders Petrie's observations of the condition of the chamber itself.

> The King's Chamber was more completely measured than any other part of the pyramid; the distances of the walls apart, their verticality in each corner, the course heights, and the levels, were completely observed. On every side the joints of the stones have separated, and the whole chamber is shaken larger. By examining the joints all-round the second course, the sum of the estimated openings is 3 joints opened on N. side, total = .19 ; 1 joint on E. = .14 ; 5 joints opened on S. = .41 ; 2 joints on W. = .38. And these quantities must be deducted from the measure, in order to get the true original lengths of the chamber. I also observed, in measuring the top near the W., that the width from N. to S. is lengthened .3 by a crack at the S. side.
>
> These openings or cracks are but the milder signs of the great injury that the whole chamber had sustained, probably by an earthquake, when every roof beam was broken across near the south side; and since which the whole of the granite ceiling (weighing some 400 tons) is upheld solely by sticking and thrusting. Not only has this wreck overtaken the chamber itself, but in every one of the spaces above it are the massive roof beams either cracked across or torn out of the wall, more or less, at the south side; and the great eastern and western wall of limestone, between and independent of which, the whole of these construction chambers are built, have sunk bodily. (Petrie 1883, 27)

The King's Chamber/Grand Gallery assembly is a most magnificent piece of evidence that presents more awkward questions than the enigmatic King's and Queen's Chamber shafts. Within the King's Chamber sits a granite box, which has been referred to as a sarcophagus by Egyptologists. The dimensions of the box indicate it was installed in the chamber before the chamber had been completed, as its dimensions are larger than the low passageway that is the only access to the chamber.

The color of the box has been reported as being chocolate brown. It has also been severely damaged, with the southeast corner broken at the top. I had proposed in *The Giza Power Plant* that the displacement of the King's Chamber walls and the cracked beams above were not caused by an earthquake but by forces within the chamber itself, following the introduction of oxygen into a highly energized hydrogen atmosphere that

resulted in an explosion. To support my contention, I referred to the lack of disturbance and precision of the lower passages and chambers as well as the base upon which sit the pyramid stones that covered 13 acres of limestone bedrock with no greater variation in level than ⅞ inch (2.22 cm).

My theory was related to several pieces of evidence. The first is the King's Chamber North Shaft, which had dimensions that would be suitable for use as a waveguide. Because the width of the shaft is 8.4 inches (21.34 cm) and the wavelength of hydrogen is 8.309 inches (21.104 cm), I proposed that hydrogen was created in the Queen's Chamber below and filled the open spaces of the pyramid. I will address, in the following chapters, more evidence revealed since that reinforces this theory. The second piece of evidence is the damage to the chamber and beams above. The third is the granite coffer's difference in color and its damaged corner.

In *The Giza Power Plant* I also posited the theory that the top surface of each granite beam above the King's Chamber, rather than receiving less attention than the flat, square sides and bottom surfaces, were crafted with more attention but from a different class of worker.

> Rather than suffering from a lack of attention, therefore, the rough top surfaces of those granite beams in the King's Chamber have been given more careful and deliberate attention and work than the beams' sides or bottoms. Before the ancient craftspeople placed them inside the Great Pyramid, each beam may have been "tested" or "tuned" by being suspended on each end in the same position that it would have once it was placed inside the pyramid (see Figure 4.7). The workers would then shape and gouge the topside of each beam in order to tune it before it was permanently positioned inside the pyramid. After cutting three sides square and true to each other, the remaining side could have been cut and shaped until it reached a specific resonating frequency. The removal of material on the upper side of the beam would take into consideration the elasticity of the beam, as a variation in elasticity might result in more material being removed at one point along the beam's length than at another. The fact that the beams above the King's Chamber are all shapes and sizes would support this speculation. In some of the granite beams, I would not be surprised if we found holes gouged out of the granite as the tuners worked on trouble spots. What we find in the King's

> Chamber, then, may be thousands of tons of granite that were precisely tuned to resonate in harmony with the fundamental frequency of the Earth and the pyramid! (Dunn 1998, 157)

Figure 4.7. The tuning of a single granite beam can be accomplished by suspending it between two blocks at the ends, striking it, and selectively removing material from the top side until it "rings" at the correct frequency.

A granite beam can be cut flat on the top to achieve a particular frequency when struck. It might be that its uneven top surface was cut not only to achieve a specific resonant frequency but also to equalize the release of positive hole electrons across the length of the beam, and to do that, they needed to avoid an uneven distribution of peroxy defects in the minerals. This may be considered merely speculation, nevertheless, a similar condition exists in neodymium-doped yttrium aluminum garnet (Nd.YAG) laser rods, which I became familiar with in the 1980s when processing aircraft engine parts.

While neodymium atoms in a laser rod, when excited by light, produce an infrared 1064 nm wavelength photon, peroxy defects in igneous rocks, when excited by movement, produce positive hole electron propagation. Where and in what amount of concentration they exist within their crystalline substrates is determined after the crystal is formed.

In discussing this with Robert Vawter, he introduced the idea that the movement of sound through the granite stack might be affected by the uneven distribution of materials in the granite, principally quartz, felspar, and mica, and that this could affect the coherency of sound as it exits a layer of granite beams, travels through open space, and impacts the beam above. All of this is highly speculative, of course. But then, until each hypothesis is

proven or not proven through the application of scientific principles and physics, what isn't?

> Smyth and Petrie unwittingly provided clues that this resonance theory may not only be plausible but indeed probable. Both sought an explanation for the holes gouged near the ends of these granite beams. Smyth said, *"These markings, moreover, have only been discovered in those dark holes or hollows, the so-called 'chambers,' but much rather 'hollows of construction,' broken into by Colonel Howard-Vyse above the 'King's Chamber' of the Great Pyramid. There, also, you see other traces of the steps of mere practical work, such as the 'bat-holes' in the stones, by which the heavy blocks were doubtless lifted to their places, and everything is left perfectly rough"* (Smyth 1880, 7). Rather than seeing them as holes used for lifting the blocks into place, Petrie speculated on an alternate reason for Smyth's so-called 'bat-holes': *"The flooring of the top chamber has large holes in it, evidently to hold the butt ends of beams which supported the sloping roof-blocks during the building."* (Petrie 1883, 31)
>
> Neither Smyth's nor Petrie's explanations are particularly satisfactory. The most likely and logical reason for the holes gouged near the end of the beam may have been to strategically weaken the beam in order for it to respond more readily to sound input. According to Boris Said (pronounced Sigh-eed), who was with engineer Tom Danley when he conducted his acoustical tests inside the King's Chamber, the King's Chamber's granite beams resonated at a fundamental frequency and the entire structure of the chamber reinforced this frequency by producing dominant frequencies that created an F-sharp chord. Not surprisingly, the F-sharp chord is believed to be in harmony with the Earth. While testing for frequency, Danley placed accelerometers in the spaces above the King's Chamber, but I do not know whether he went as far as checking the frequency of each beam. Boris Said shared something in his interview with Art Bell that may be some indication of where Danley was heading with his research. He said that the beams above the King's Chamber were "like baffles in a speaker." Further research would need to be conducted before any assertion could be

made as to the relationship these holes may have with tuning these beams to a specific frequency. However, when we consider the characteristics of the entire granite complex, along with other features found in the Great Pyramid, it seems clear that the results of this research will be along the lines of what I am theorizing. (Dunn 1998, 157) (Note: Unfortunately, as of today, this extensive and highly specialized research has not taken place.)

When I visited Egypt in 1986, I had already become convinced that acoustics were at play in this gigantic instrument of musical ingenuity. In 1995, I was able to privately make a recording in the King's Chamber, and I presented my observations and results in *The Giza Power Plant.* With some corrections and modifications to shorten the text, here is the essence of what I wrote:

I recently had the opportunity to confirm the acoustical phenomena of the King's Chamber in a unique and rather fortuitous way, although without Danley's instrumentation or expertise. On February 24, 1995, I paid the inspector of the Giza Plateau $100 to leave me inside the Great Pyramid after all the tourists had left and it was officially closed . . . . My backpack was weighted with some instruments I had brought along specifically to take some acoustical and electromagnetic frequency measurements . . . . I had asked for the lights to be turned off because I did not want any background electrical noise to affect the digital frequency counter with which I was equipped. I had brought this along to measure radio frequencies that I believe can be generated by the resonant chamber inside the Great Pyramid. I also had brought along a tape recorder, which I turned on and placed upon a block of granite situated close to the granite coffer, or "box" in the King's Chamber. Using this block as a work stage, I positioned my flashlight, the digital frequency counter, and a monochromatic tuner, which measures sound frequency and is used to tune musical instruments. The last batch of tourists made their way down the Ascending Passage to the outside.

When the noise faded away, I began to test the frequency of the granite box. I had read in a booklet by flautist Paul Horn (that

accompanied his album *Inside the Great Pyramid*) that the granite box resonated at a frequency of 438 cycles per second (Hz). Horn had used a Korg tuner, which is quite a bit more expensive than the Matrix tuner I was using, to perform his own acoustical tests inside the chamber. I thumped the side of the box with my fist. The tuner registered between 439 and 440 Hz. I loudly hummed that note to test the resonance of the King's Chamber. Sliding up the scale, I noted that the reverberation faded until I produced the same note one octave higher, and then the reverberation was even greater. It was then time to test for radio frequencies, and the lights were still not turned off. I was becoming concerned because I had to be out of there in 15 minutes, so I crouched back through the passageway, stood at the top of the Grand Gallery, and yelled to the guards to turn off the lights. While there, I intoned the note I had hummed earlier, then scurried back into the King's Chamber with the intent of being by my flashlight before I was pitched into darkness. At last, the hum of the lights ended abruptly and I was left with only the light from my flashlight. My heart was pounding in my chest. I was sweating profusely. I had reached the moment of truth.

Then I realized that the hum of the lights was masking the whir of fans installed in the alleged "air channels." The guards had turned the lights off, but, as I discovered later, they could not turn off the fans without a key to the electrical box that controlled them. Disappointed that I would not be able to use any data, I went ahead and took some readings anyway.

Back in my hotel room I played the tape back and discovered three very interesting acoustical phenomena. First, the tape had picked up overtones to the note I was humming in the King's Chamber. I had been unable to hear them while I was in the chamber because I was the source of the sound. This was a very exciting discovery, as it supported my theory on the King's Chamber. I tempered my enthusiasm, however, with the thought that it might be the equipment that was resonating at a higher frequency and generating this overtone. Mine was not a very expensive tape recorder, but still I believe the overtones were generated by the chamber complex itself (including the granite ceiling beams) because of the King's Chamber's true design and purpose. The

> second discovery revealed that when I was on the Great Step at the top of the Grand Gallery yelling to have the lights turned off and then humming the tone, the playback sounded as if I had never left the room. At that moment, except for a small passageway, there were thousands of tons of granite and limestone that separated me from the recorder, and my voice was being projected into a 28-foot-high and 157-foot-long expanse of space. The third revelation was that the footsteps and noises I made, while traversing the low passage to and from the Grand Gallery, reverberated in the King's Chamber and caused it to resonate at its natural frequency. This was noted on the Matrix monochromatic tuner that was turned on as I played back the tape. My footsteps and noises were registering at approximately 440 Hz. I particularly noted that the fluctuations of the tuner during this section of the playback were not as great as those I had observed inside the King's Chamber when I was humming the frequency (Dunn 1998, 140–143).

Robert Vawter

> In February 1997, I learned from researcher Stephen Mehler about a sound engineer named Robert Vawter who had done some studio analysis of a tape recording that he (Mehler) had made inside the King's Chamber. As he related it to me, those results were the same as mine. I was given Vawter's phone number and promptly gave him a call. Vawter confirmed what Mehler told me. He said that he had digitally processed the tape provided by Mehler, and he was able to isolate harmonic overtones of the intoned frequency. Vawter claimed that the King's Chamber was designed specifically as a resonant chamber in which the sound of specific frequencies would resonate. He said that every dimensional feature of the chamber he had studied indicated the manifestation and form of harmonic resonance. (Dunn 1998, 143)

In recent conversations, Vawter told me that he was inspired to gather acoustic data from the pyramids by Abd'el Hakim Awyan, a well-known personality and guide who lived in the village of Nazlet El Samman, which is located next to the Great Sphinx. Of particular interest was their discussion about King Sneferu's two pyramids at Dahshur. Awyan's

interpretation of Sneferu is that the name means Double Harmony. He also referred to the pyramids as Per Neters and interpreted that to mean Places of Nature. Vawter not only provided an analysis of Mehler's recording, but also collected acoustical data from Sneferu's Red Pyramid. Since his studies in the '90s, Vawter has expanded his research into pyramid acoustics, and in Appendix A he has kindly provided a deeper understanding of his thorough research, which encompasses not just pyramid acoustics but significant observations regarding ancient acoustics in general.

Dustin Carr

On June 12, 2003, I received an email from physicist Dustin Carr:

> Dear Mr. Dunn,
>
> I am impressed with your work on reverse engineering the great pyramid. I am in strong agreement with you that there was a purpose for the pyramids, and power generation is the only thing that would justify the size of the structure. I have a Ph.D. in physics from Cornell, 2000, and have worked as a lead researcher/manager at Bell Labs. If you search the web for "nanoguitar" and "lambda router" you will find some reference to my work.
>
> I have some ideas that I think would go far in helping you refine the theory, but I need a little more data. There are some types of "engines" that were not considered in your book, but I need to know the precise dimensions of the various parts; the kings chamber, the lengths of the shafts, the sarcophagus. I am an expert in vibration physics, and have access to certain tools that could be of benefit in the acoustical analysis.
>
> I hope to hear from you soon.
>
> Dustin W. Carr, PhD
>
> (Email received 6/12/2003 9:37:16 AM)

Naturally, I was extremely happy and privileged to receive Carr's offer of help. I communicated with him and his colleague, Stephen Turner, PhD, also of Cornell, off and on for several months. In this time, I learned that Carr's preliminary calculations using the geometry and dimensions of the King's Chamber and its shafts confirmed my original claim that the ancient

Egyptians' design intent was acoustics. However, it was more complicated than I had imagined. The design intent was not the application of simple acoustics but reflected a sophisticated knowledge of nonlinear acoustics, of which at the time of our communication in 2003 we still had a lot to learn.

Carr reached a point in his analysis when an official research proposal was needed so that on-site measurements and acoustic samples could be taken. For many reasons, this failed to materialize and a tantalizing question mark exists in its place. Robert Vawter's analysis, as described in Appendix A, reinforces that question mark, and we both hope that the information in this book will provide impetus for qualified people with, as Professor Sherbini appropriately pointed out, organizational weight behind them to take up the challenge and provide solid answers to our questions.

I learned through recent communication with Carr that he was unable to be involved in this research at this time, though he told me I was welcome to share his previous studies and comments.

WHEN THE MUSIC STOPPED

Throughout the Earth's history, tranquility has frequently been violently interrupted. Earthquakes, volcanos, and associated devastation continue unabated to frequently remind us that the Earth is a dynamic planet and what might exist on its surface through the ingenuity and labors of humans can be wiped out in an instant. Less frequent than the general localized damage from the Earth's internal forces are the occasional interruptions visited by external forces that affect the entire planet. Asteroids, meteorites, and coronal mass ejections from the sun are known to have impacted the Earth in the past, causing apocalyptic global destruction.

While the body of knowledge that describe these events in detail is beyond the scope of this book, I accept that cataclysms have occurred in the past and that one particular cataclysm reduced a large section of the civilization existing at the time to ruin. While I am not able to specifically identify which one, I can confidently say that much of what we now recognize as advanced technology in the ancient world is the result of human activity that was violently interrupted by outside forces that brought everything to a halt. While Egyptologists have surmised that the Great Pyramid at Giza was built in the Fourth Dynasty, or about 4,500 years ago, strong arguments are made to consider that the pyramids were constructed

thousands of years earlier, before a cataclysm brought them and their creators to ruin.

The damage to the pyramids and other magnificent examples of engineering genius crafted in igneous rock was so great that the survivors had no hope of restoring their world to the level of accomplishment they previously enjoyed. Such would be our own fate should a similar event happen in the future.

Taking all this into consideration, I argued that the most likely force that pushed out the walls of the King's Chamber and caused the beams above to crack would have been a hydrogen explosion inside the chamber that probably followed a cataclysmic event that overcame the Earth and destroyed most of the existing civilization. With the pyramids being finely tuned to resonate with the Earth's natural frequencies, the introduction of an outside force that impacted the Earth was too much for the pyramids to handle. They started to shake apart. Casing stones were shaken off. Some, like the pyramid at Meidum, have casing stones piled up around the base. Other structures, like the Sun Temple at Abu Ghorab, have large limestone blocks that appear to have been ejected from their original position, with at least one I have seen having cracks running through at awkward angles, leaving one to wonder how and why they are so situated. Some, such as the pyramid at Abu Rawash, were under construction and the work was not completed.

The Unfinished Obelisk at Aswan, I believe, was not abandoned because it had developed a crack. Considering the enormous amount of work that went into ploughing out a deep channel around it, a lot of useful granite had been exposed that could still have been used, even if not for an obelisk. Like every other work in progress at the time the cataclysm hit, everything came to a violent end.

EVIDENCE OF CONFLAGRATION IN THE GREAT PYRAMID

In *The Giza Power Plant*, the evidence used to support the explosion hypothesis was the use of hydrogen suggested by the dimension of the North Shaft, the localized damage to the chamber, the coffer, which, as I surmised, was cooked, and the theory that these devastations were caused by a cataclysmic event that affected not just the Great Pyramid but all

structures throughout Egypt. I was not aware when the book was published in 1998 that other evidence existed in the Grand Gallery to support this theory but was hidden beneath a layer of dirt and dust.

Recognizing that the Grand Gallery was not in pristine condition, as it would have been after it was first built, I addressed what possible effects a violent explosion in the King's Chamber may have had on this critical section of the machine.

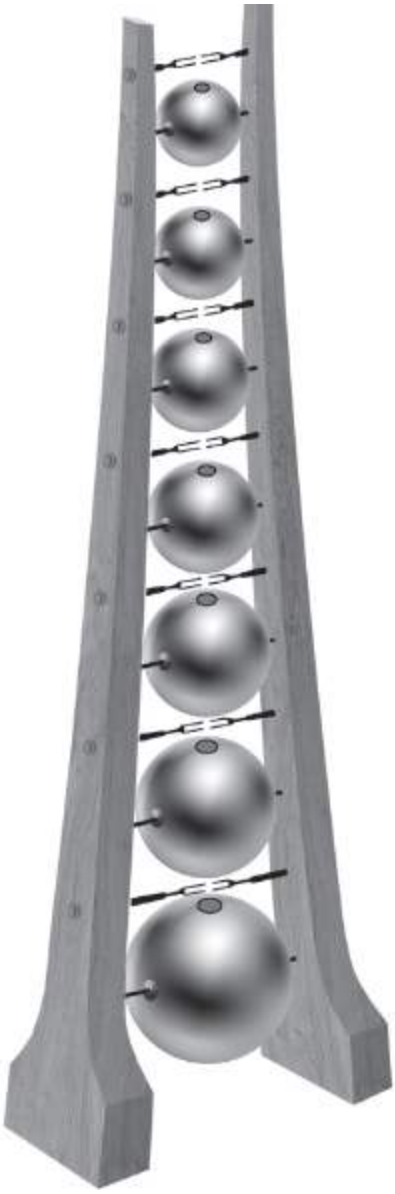

Figure 4.8. Resonator assembly.

> The awesome force unleashed inside the King's Chamber—of such magnitude that it melted granite—also would have consumed other susceptible materials. If the resonators in the Grand Gallery were made of combustible material, such as wood, they most likely would have been destroyed at the same time. Evidence to support this speculation comes from reports that the limestone walls in the Grand Gallery were subjected to heat and, as a result, the limestone blocks calcinated or burned. The disaster that struck the King's Chamber, therefore, may have been responsible for destroying the resonators. (Dunn 1998, 212)

There is no information that informs us what shape and out of what material the proposed resonators were made. While I previously discussed the use of wood, this was based on its natural ability to resonate and contribute to the performance of a musical instrument. In considering this material for use so close to the energy center in this electron harvester, I was concerned about the level of heat the resonators would be exposed to under normal operating conditions. My current conclusion is that it is still an open question. However, whatever material the resonators were made of succumbed to the hydrogen explosion.

My illustration of the resonators has not changed much since the publication of *The Giza Power Plant*. That is because whatever I might change it to would be just as speculative as what I previously imagined, which was based on the dimensions and features of the gallery. This included the use of the 27 pairs of slots that are spaced along the two ledges on either side of the central channel. Based on harmony and resonance, I proposed that frames were inserted into the slots and held in place vertically using the grooves that were cut into the third corbel.

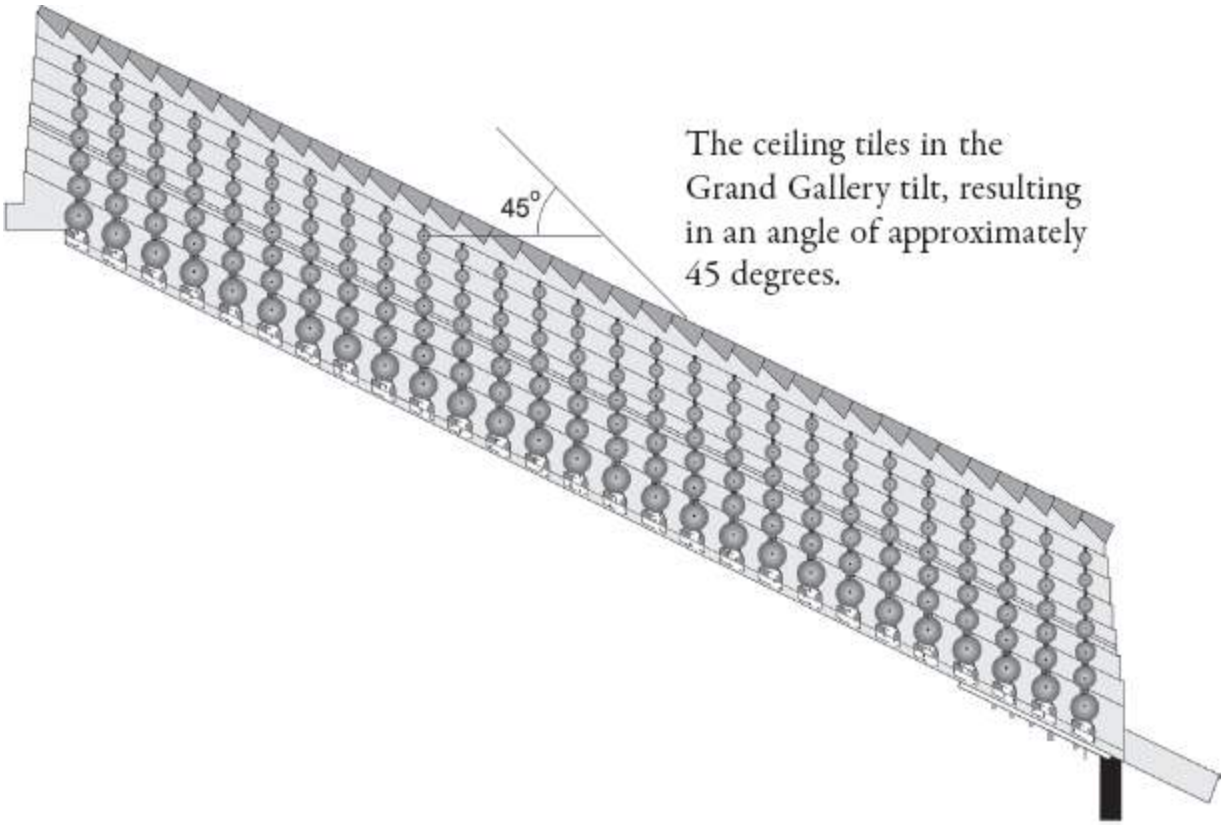

Figure 4.9. Resonator assembly in the Grand Gallery. (See also color plate 14.)

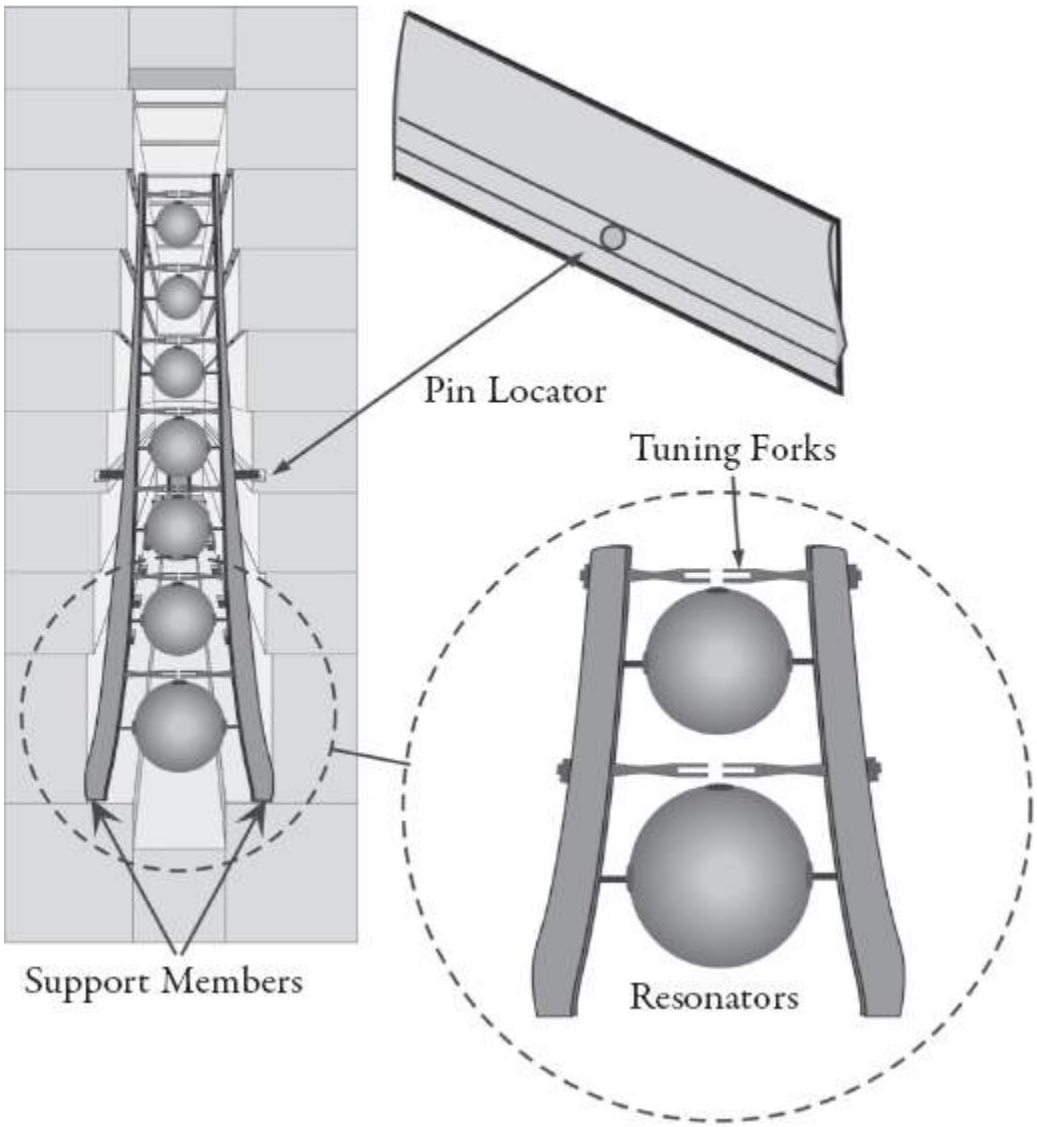

Figure 4.10. Once the lower part is in the ramp slots and the pins are located in the groove, the resonator assemblies are prevented from moving. (See also color plate 14.)

EXPLOSIVE NEW EVIDENCE

I was able to see more signs of damage in the Grand Gallery during a visit in 1999, when I was being filmed during the New Millennium Conference. When the bright camera lights illuminated the gallery wall, I noted damage marks on each corbel that formed a line above one of the slots. As my time was spoken for, I did not have the chance to follow up on this.

Figure 4.11. Photograph of ceiling of Grand Gallery in 2001, taken from the step at the south end. (See also color plate 14.)

Another opportunity came in 2001, when, as I discussed earlier, I was being filmed by Grizzly Adams Productions for a Pax Television documentary that also featured Zahi Hawass. It was a fortuitous time because the pyramid had been closed for cleaning for several months. Rumors spreading around the internet claimed that the reason given for closing the Great Pyramid for cleaning was an excuse to surreptitiously dig a tunnel to connect with the Queen's Chamber South Shaft and access what was behind Gantenbrink's door. Therefore, I was greatly appreciative of Hawass giving Gail Fallen and me permission to enter the Great Pyramid, which was still closed.

Figure 4.12. Resonator frame with scorch marks. (See also color plate 14.)

Little did I know at the time that this visit inside the Great Pyramid would reveal additional critical evidence that was not known when *The Giza Power Plant* was published.

Indeed, there is no question that the inside of the Great Pyramid had been cleaned. Comparing previous photographs of the Grand Gallery with those taken after the cleaning leaves no doubt about this fact. Strikingly, the ceiling of the gallery immediately got my attention and caused my jaw to drop. The tiles above the pairs of slots on each side of the gallery had scorch marks. Evidence supporting the scenario I discussed in 1998 had been revealed after the dust and soot were removed by cleaning. Intense heat created by burning resonators had left an indelible signature etched into the limestone tiles.

THE AFTERMATH

There is no shortage of suppositions and probabilities about what happened after the Great Pyramid was violently shaken and shuddered to eerie stillness. How extensive was the wreckage inside? Early explorers were faced with clearing tons of material from the Descending Passage, the Subterranean Chamber and Well Shaft, and the Pit that begins at the bottom of the Grand Gallery and connects with the Descending Passage just north of the entrance to the Subterranean Chamber. Masonry with unusual shapes and features was noted, such as half drill holes evident along the edge of a piece of granite. Among the debris was a prism-shaped piece of stone, which was surmised to be the piece that covered the granite plugs located where the Descending and Ascending Passage meet. That supposition may be correct, although another possible location for the piece may have been in the Grand Gallery itself. Was it one of many that were positioned on the ledges on both sides of the Gallery so as to match the tiled ceiling? It's a point to keep in mind when considering restoring the pyramid to its functioning status.

Reports of debris being cleared away to gain access to various parts of the pyramid leave a question mark regarding what was taken out and what its function was in this electron harvesting machine. A compelling story has taken firm hold of the imaginations of scholars, researchers, and readers about the history of discovery within the Great Pyramid. Specifically, the adventures undertaken by Caliph al-Ma'mun who gained entry into the Great Pyramid in AD 812 with great effort by carving a tunnel from the outside to the Descending Passage. Reportedly, he had searched the north face of the pyramid for days looking for the entrance, and after reaching frustration with his lack of success, began lighting fires and quenching the hot stone with vinegar to persuade the limestone to yield to the action of his hammers and chisels more easily.

His mission was inspired by rumors of untold treasures held inside, such as glass that might bend but will not break. Recovering these treasures seemed to overshadow more unseemly rumors about naked women with large teeth who waited to seduce young men. But, on the other hand, perhaps those rumors were an attraction also?

Nevertheless, it is reported that Mamun and his men chiseled away for several months before breaking through into the Descending Passage.

However, this story is questioned by researchers Ralph Ellis and Mark Foster in their article "The Enigma of Mamun's Tunnel," in which they present a cogent argument suggesting that rather than cutting the tunnel from the outside in, Mamun cut it from the inside out after gaining access to the inside of the pyramid the same way Strabo did in 24 BC—through the original entrance.

> The question is, therefore, why could Mamun not see these telltale marks and the original entrance to the pyramid, that lay only a few meters above him? Why could he not see the handle on the door, or the scuff-marks on the smooth exterior? And knowledge of the location of the true entrance must still have been known in this era, so why could none of the locals be 'persuaded' to point it out? And this apparent invisibility of the original entrance could not have been because it was covered by sand, for instance, because Mamun's tunnel lies below the level of the real entrance. So what was the problem? Why was so much effort expended in digging a new tunnel, when the original entrance lay just above it? (Ellis and Foster 2000, 42)

Ellis and Foster answer this question by suggesting that Mamun discovered and removed more from inside the Great Pyramid than has officially been revealed:

> It is highly probable that the real reason for constructing the forced tunnel was not to get into the pyramid, but rather to get something out. Whatever it was, though, it must have been small enough to go down the first part of the ascending passage, but it was too long to go around the bend between the descending and ascending passageways. The only alternative for these intrepid but highly destructive explorers, was to dig a tunnel directly outwards from the junction of the two passageways, completely bypassing the internal passageway constriction. (Ellis and Foster 2000, 42)

Ellis and Foster proposed that it might have been the lid from the sarcophagus that could not be wrestled around the bend to be pushed up the

Descending Passage and through the original entrance. Knowing the weight of similar items that have been found, one would surmise that such an item would have been extremely heavy, and lowering it down and through a horizontal tunnel was preferred to pushing it up a passageway angled at 26 degrees. The other possibility is that there were items that were recoverable and able to navigate the Ascending Passage but too long to make the turn at the Ascending/Descending Passages junction.

I fully support Ellis and Foster's analysis. Their arguments against Mamun's generally accepted reason for digging his tunnel and the alternative scenario they present make perfect sense. The question is, other than a sarcophagus lid, what else might Al Mamun and his men have carried out of the Great Pyramid that was so valuable that they went to the trouble of digging their tunnel?

Immediately, my thoughts turned to the question of what happened to any possible remnants of the Grand Gallery resonators. If some of the tall frames survived the fire, most certainly they could not have been taken up the Descending Passage. It boggles the mind to think that perhaps somewhere in Egypt a stash of materials exists that may once have been housed in the Grand Gallery and performed in harmony with the Earth inside a mountain of stone. However, nothing has officially been disclosed about any stash of materials related to vibration, frequency, harmony, and music that could be interpreted to have come from the Great Pyramid. Unofficially though, in 1997 a tantalizing post appeared on a Keelynet bulletin board that disclosed a clandestine and unauthorized visit to a mysterious room in an Egyptian museum.

"Anomalous" Ancient Egyptian artifacts

Author: No name given.

Date: Wed, 10 Dec 1997 17:10:09 +0000

Some years ago an American friend picked the lock of a door leading to an Egyptian museum store-room measuring approx 8 feet × ten feet [sic]. Inside she found "hundreds" of what she described as "tuning forks".

These ranged in size from approx 8 inches (20.03 cm) to approx 8 or 9 feet (2.44–2.74 m) overall length, and resembled catapults, but with a taut wire stretched between the tines of the "fork". She

insists, incidentally, that these were definitely not non-ferrous, but "steel".

These objects resembled a letter "U" with a handle (a bit like a pitchfork) and, when the wire was plucked, they vibrated for a prolonged period.

I know of nothing that can corroborate the story above, but I include it out of interest because when I created the illustration of the resonator for *The Giza Power Plant*, I included tuning forks as part of the assembly. I also included what I described as Helmholtz resonators, which worked in unison with the tuning forks. While the story should be treated with some measure of doubt until strong evidence is revealed that would support it, I can't help wondering why someone would make the story up. I can say with certainty that if it is a fabrication, *The Giza Power Plant* did not inspire it because the post appeared eight months before my book was published. Neither did this story inspire what is written in my book. When the post appeared on the bulletin board, my manuscript was already finished and at the publisher, and I did not learn about it for a long time afterwards. Perhaps more information will be revealed someday that will corroborate the story, but for now it will remain a tantalizing mystery that finds a home among many other tantalizing mysteries.

RESONATOR CLARIFICATION

The theory regarding Helmholtz resonators being installed in the Grand Gallery is not without challenge. But then, everything is subject to challenge, and rightly so. Carr shared his opinion that the resonators inside the Grand Gallery may have functioned less like a Helmholtz resonator, such as the way that the hollow body of a stringed instrument like a guitar performs, and more like the strings on that instrument. (An assembly of large, strung tuning forks, perhaps?)

Carr's opinion was based on his analysis that the King's Chamber, by its geometry and dimensions, functioned as a large Helmholtz resonator itself. Carr's professional analysis, when combined with Robert Vawter's computer modeling, provides support to the observations made by flautist Paul Horn, who played his flute on the Great Step at the top of the Grand Gallery and noted that the gallery response was flat, but from behind him in

the King's Chamber he heard a strong reverberation of the sound. These analyses are in agreement with my own observations when in 1995 I played back the tape that was recording inside the King's Chamber when I was in the Grand Gallery calling for the guard to turn off the lights. The playback on my tape recorder was as though I had not left the chamber (Dunn 1998, 161–162).

Carr may be correct, but there is another aspect of ancient acoustics that Robert Vawter recently shared with me that might contribute to the discussion—the historical use in Roman amphitheaters of Helmholtz-type vessels that were placed within cavities beneath the terraced seats to enhance the sound. In Appendix A, Vawter will discuss this in more detail and draw upon Vitruvius's work, *The Ten Books on Architecture* (Vitruvius 1914). See also color plates 15 and 16 for an illustration of acoustic phenomena observed by Vawter in the Grand Gallery.

It would be a mistake, however, to isolate the Grand Gallery and King's Chamber as the only features that were acoustical in nature. The entire pyramid and all its parts demonstrate unique acoustic properties—with reports of sound originating in the Subterranean Chamber being heard in the King's Chamber, the passageways that carry the sound through the pyramid are analogous to organ pipes, as Vawter will discuss in his appendix. Obviously, as anyone who has crawled through these passages will tell you, they were not designed to welcome and provide a comfortable route for humans to reach their destination.

Then there is the Antechamber. I have little to add to what I wrote in *The Giza Power Plant* about this critical element, which, I speculated, served as an acoustic filter. But, again, I am not the final judge of what it was used for or the physics behind it. These answers must come from experts like Carr or others with similar education and training.

The same conclusion applies to my analysis of the Queen's Chamber. While the next two chapters will reveal that my principal observations and predictions have been supported by evidence, there are still better qualified specialists than I whose professional analyses, as you will find in the next chapters, carry more weight.

FIVE

THE QUEEN'S CHAMBER SHAFTS

The world's fascination and focus always turns to Egypt and its mysteries when a new discovery is made. Following a string of explorers and researchers before and during the Victorian era, fascination with Egyptian tombs and what they might reveal reached a fever pitch in 1922 when archaeologist Howard Carter (9 May 1874–2 March 1939), working under the patronage of George Herbert, the 5th Earl of Carnarvon (26 June 1866–5 April 1923), discovered Tutankhamun's tomb and revealed a treasure trove of priceless funerary artifacts to the world.

With this discovery, the question of the existence of secret chambers containing Khufu's mummy inside the Great Pyramid gained more relevance. If a tomb with such fabulous riches as Tutankhamun's could exist in a dusty valley on the west bank of the Nile near Luxor, surely it would be quite reasonable to assume that a grand pyramid—the largest structure that had ever been built—would be the repository of treasures far more plentiful and extravagant in design and materials? The apparent wealth available to the people who invested in such a stupendous structure would surely dwarf every artifact that has been found in every tomb discovered in the Valley of the Kings and elsewhere in Egypt.

If we look back at the numerous attempts to discover something new inside the Great Pyramid, we can identify a single motivation for those who held the keys to this edifice: the search for the undisturbed tomb of Khufu, or Cheops as he is also known. Although the three chambers we know about have yielded nothing, Egyptologists still believe that evidence of the king's interment can be found.

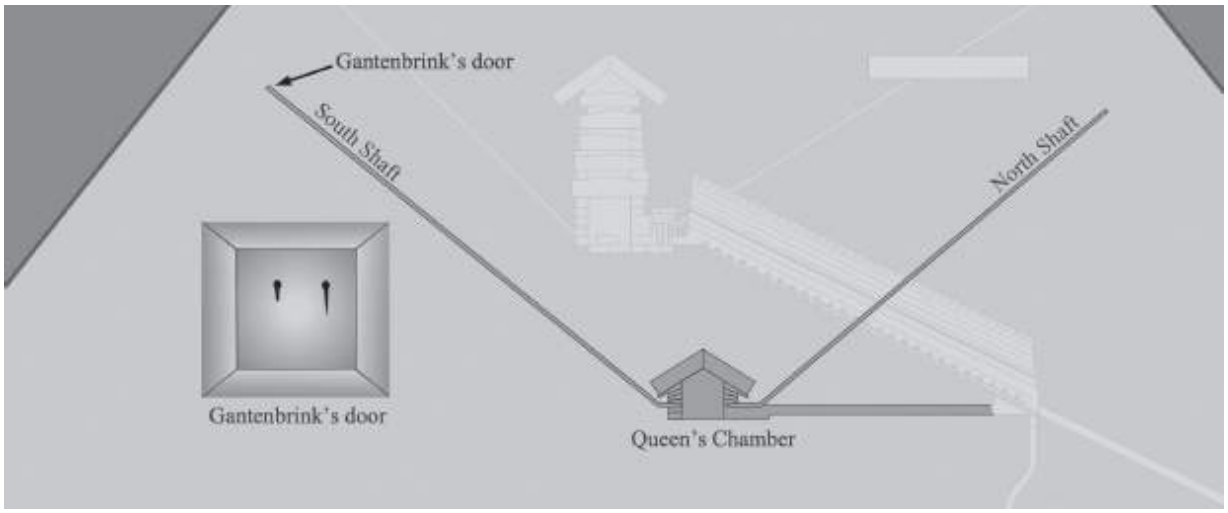

Figure 5.1. The Queen's Chamber shafts and Gantenbrink's door.

I had studied the Queen's Chamber and its mysterious and confounding shafts for a long time, trying to figure out how they may have functioned in what I had come to believe was a massive machine. I accessed through the library or purchased just about every book I could find that might have some information about the shafts. One of the most useful reports of their discovery can be found in Charles Piazzi Smyth's book, *The Great Pyramid: Its Secrets and Mysteries Revealed*.

> Newly discovered Air Channels in the Queen's Chamber.
>
> Now in what is just passed, we have seen a whole series of connections between the actually existing measurable facts of the Queen's Chamber, and scientific portions of the ultimate, and originally secret, design of the Great Pyramid. Therefore, although some of the early travellers [sic] have spoken fearfully of "the grave-like smell and noisome odour [sic] of this room, causing them to beat a rapid retreat," the room must have acquired that revolting character from modern vilifying, rather than ancient construction; for what its builders put into it, as we see above, is not of a nature to experience any fleshly corruption.
>
> Indeed, in its ancient planning, the Queen's Chamber would appear to have been intended someday to be remarkably well ventilated. For the chief item of latest discovery at the Great Pyramid, is that one which was made in 1872 by Mr. Waynman

Dixon, in company with his friend Dr. Grant, and with the assistance of one of his English workmen from the bridge he was then erecting over the Nile; and is to the effect that this Queen's Chamber has, in a peculiar state of readiness, though never yet brought into action, two ventilating channels in its north and south walls, nearly similar to those in the King's Chamber.

Perceiving a crack (first, I am told, pointed out by Dr. Grant) in the south wall of the Queen's Chamber, which allowed him at one place to push in a wire to a most unconscionable length, Mr. W. Dixon set his carpenter man-of-all-work, by name Bill Grundy, to jump a hole with a hammer and steel chisel at that place. So to work the faithful fellow went, and with a will which soon began to make a way into the soft stone, when lo! After a comparatively very few strokes, flop went the chisel right through into somewhere or other. So all the party broke away the stone round about the chisel hole, and then found a rectangular, horizontal, tubular channel, about 9 by 8 inches (22.86–20.32 cm) in transverse breadth and height, going back 7 feet (2.13 m) into the wall and then rising at an angle of about 32° to an unknown dark distance.

Next, measuring off a similar position on the north wall, Mr. Dixon set the invaluable Bill Grundy to work there again with his hammer and steel chisel; and again, after a very little labour, flop went the said chisel through, into somewhere; which somewhere was presently found to be a horizontal pipe or channel of transverse proportions like the other, and, at a distance within the masonry of 7 feet, rising at a similar angle, but in an opposite direction, and trending indefinitely far.

Fires were then made inside the tubes of channels; but although at the southern one the smoke went away, its exit was not discoverable on the outside of the Pyramid. Something else, however, was discovered inside the channel, viz. a little bronze grapnel hook; a portion of cedar-like wood, which might have been its handle; and a grey-granite, or green-stone ball, which from its weight, 8,325 grains, as weighed by me in November, 1872, must evidently have been one of the profane Egyptian mina weight balls, long since valued by Sir Gardner Wilkinson at 8,304 grains.

To this passage, Smyth added the following footnote:

> Thin flakes of a very white mortar, exuded through the joints of the channel, were also found; and being recently analyzed for me by Dr. William Wallace of Glasgow, were proved to be composed not of carbonate, as generally used in Europe for mason's mortar, but sulphate, of lime; or what is popularly known as "plaster of Paris" in this country. (Smyth 1978, 427–429)

There is a full chapter in *The Giza Power Plant* that discusses the history of exploration and discovery in the Queen's Chamber and its shafts before 1998. Within the chapter, I presented a formula given to me by chemical engineer Joseph Drejewski for creating hydrogen. His formula specified the mixing of two chemicals, hydrated zinc solution and a dilute mixture of hydrochloric acid and water, with the hydrochloric acid feeding into the chamber through the South Shaft and hydrated zinc through the North Shaft. Obtaining these chemicals, I mixed them in a vessel with a "chimney" on top and was able to demonstrate its functionality by igniting the hydrogen gas that was created from the reaction.

I also made an attempt to explain Dixon's discovery of a grapnel hook, cedar-like wood, and stone ball by theorizing about their function within the shaft. However, for the purpose I proposed, which was to create an electrical circuit, they are not necessary, so I must take them out of the equation and place a question mark as to why and for what purpose they were there. A logical reason would be they were used in an attempt to explore the shaft and possibly retrieve what may be there.

Recognizing that other formulas may be defined, I also suggested that sulfur could have been included in one, which may explain the existence of the "grave-like smell and noisome* odor" of the room that caused early explorers to "beat a rapid retreat."

Figure 5.2. Using Drejewski's formula to create hydrogen.

1. Was the disgusting smell that caused early explorers to beat a hasty retreat from the chamber connected to a chemical process that used sulfur? Hydrogen sulfide is particularly odorous, exuding a smell similar to rotten eggs. This gas is formed by the combination of sulfur with hydrogen. While early explorers expected to be confronted with a certain amount of bat dung inside the pyramid, it seemed as though the smell in this particular chamber was more pronounced than in the rest of the pyramid. Again, the composition of the salts on the chamber's walls may help clarify this investigation, as sulfur-bearing compounds may have formed these salts.
2. Where did Caviglia get the chunks of sulfur that he burned in the Well Shaft? While it was a practice of early explorers to burn sulfur to purify unhealthy air, it would be most helpful to know whether or not he had the sulfur with him or if it was already there.
3. If a chemical exchange process was separating hydrogen and if a catalyst was being used in the Queen's Chamber, would sulfur play a part in the operation or perhaps regeneration of the catalyst? (Dunn 1998, 195–196)

The questions asked were, as it turns out, reasonable and logical. In 2015, Brett Cohen, PhD, published an article in *Nexus* magazine that examined my theory regarding the shafts and proposed an alternative chemical process that included sulfur as one of the possible elements used. If Cohen's formula was used by the ancient pyramid builders, it may explain Smyth's anecdotal report of early explorers "beating a hasty retreat." His article is reprinted with permission as Appendix D in this book (Cohen 2015, 43–46).

I know Drejewski's formula works, and I demonstrated it publicly for the History Channel's *Ancient Aliens* show. I accept Cohen's formula and thank him for his analysis. The reason Cohen's formula seems to fit more accurately is that it explains the horrible smell suffered by early visitors to that chamber. But how could this smell have survived the passage of time since the pyramid was first built and used? The other question is, do other pyramids, assuming that they were built for similar purposes, exhibit the same lingering odor of ancient chemicals?

Well, at least one does that I have experienced. A single chamber in the Red Pyramid at Dahshur smells strongly of ammonia. Why? Was Cohen's other chemical solution employed in this pyramid? This is the uppermost chamber in the pyramid, which can be reached by passing through other chambers and climbing several flights of recently constructed wooden stairs. I obviously have not been in all the pyramids in Egypt, but a lingering chemical smell in a remote chamber would be on my list of observations should I find myself out in the field again.

Until recently, with the muon scanning of the Great Pyramid, and the thermal imaging that revealed anomalies on the east side of the pyramid, attention has been focused for the past 27 years on the Queen's Chamber and its mysterious shafts. Even though I believe that more exciting data could be gathered by a thorough scientific examination—with an emphasis on acoustics—of the King's Chamber and all its parts, including the multiple layers of monolithic granite beams above it, worldwide attention was riveted on mysteries surrounding the enigmatic Queen's Chamber shafts that reach for the sky with no known termination point.

GANTENBRINK'S PYRAMID EXPLORATION

For 121 years following Waynman Dixon's discovery, the dark mysteries inside the Queen's Chamber shafts tantalized those who pondered on the shafts' reach. Where do they end? Are there secret doors on the outside of the pyramid that can be opened to access their exit point? Then in 1993, a flurry of excitement rippled around the world when information was released about a remarkable discovery inside the Great Pyramid. German robotics engineer Rudolf Gantenbrink, who had been contracted by the German Archaeological Institute in Cairo to install ventilation fans inside the pyramid's King's Chamber shafts, requested and received permission to design a robot that would explore the shafts inside the Queen's Chamber to try and answer the more-than-century-old question. Unlike the shafts leading from the King's Chamber, these approximately 8 inch (20.32 cm) square shafts had no known exit point on the outside of the pyramid.

The robot, named Upuaut II (meaning opener of the ways), was equipped with lights, camera, and laser pointer, and has received more fame and recognition that any other similarly equipped explorer on the subject. What the robot revealed to the world was a termination point high in the body of the pyramid. After traveling 220 feet (67 m) at an angle of 39 degrees, Upuaut II came to a dead end when it was faced with a solid limestone block barring the way. Protruding through the block were two mysterious, presumed-to-be-copper pins that were bent down against the surface of the rock. In *The Giza Power Plant*, I described these copper pins as electrodes that maintained head pressure by signaling the need for more chemicals to be pumped into the shaft when the liquid dropped. I theorized that the chemicals were pumped up a vertical shaft that connected with a space behind Gantenbrink's door.

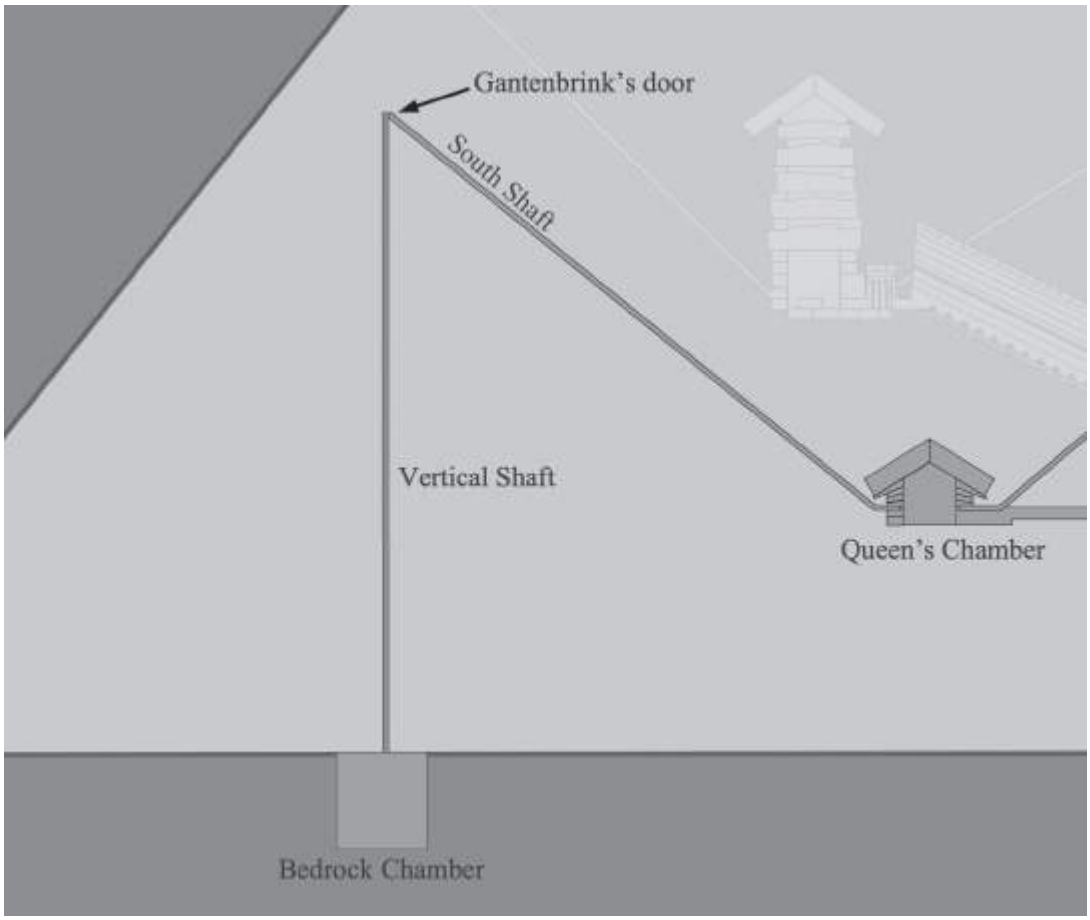

Figure 5.3. Queen's Chamber South Shaft with vertical shaft.

The discovery of this barrier posed a dilemma for Egyptologists. Simply by virtue of its existence, the popular belief that the King had changed his mind about being entombed in the Queen's Chamber and decided to have his eternal resting place higher up in the pyramid was brought into question, because the termination point of the shaft was higher than the King's Chamber. The obvious question arising from this discovery is, "Why continue to construct these shafts that did not connect with the Queen's Chamber or the outside of the pyramid if the Queen's Chamber was not going to be used?" When Gantenbrink sent his robot trekking off into the unknown, Egyptologists did not know that what the robot would discover would challenge their theory and call it into question. They had to provide an answer for the discovery, and one that would make sense. As it was established that deceased kings were not buried with their queens, they modified their theory and now claim that the Queen's Chamber was a

dummy chamber and that the shafts were symbolic features through which the King's soul exited the pyramid, by magical means, into the sky. Gantenbrink, quite properly, considering the shaft is a mere 8 in (20 cm) square, dubbed the blocking stone a USO (Unidentified Stone Object). However, the official description was "door," and the popular reference to the discovery became known as Gantenbrink's door. Was it because a door inspires the possibility of something existing behind it that Gantenbrink's preferred nomenclature was ignored?

For the theory proposed in *The Giza Power Plant* to have validity, whatever is discovered behind Gantenbrink's door must be reconcilable within the context of the pyramid being a power plant—or electron harvester. Adhering to scientific principles, what I had theorized should be falsifiable. In other words, it should be available and subject to scrutiny, testing, and verification to determine without doubt whether it is either true or false. If a royal chamber full of funerary trappings and a mummy is discovered beyond this barrier, then what I have proposed in my book is severely weakened and may be null and void. Within the framework established by Egyptologists, based on the standards they have established for the explanation of evidence with the pyramids, whatever is discovered can be explained away by invoking mysterious and magical occult symbolism, a theory that is impossible to prove and is, therefore, unfalsifiable and unscientific.

There is no mystery about where the King's Chamber shafts end. They exit the pyramid cleanly with no ambiguity. The Queen's Chamber shafts, however, do not, and the Egyptologists' hope was that they lead to the long-wished-for, sought-after, treasure-laden burial room of King Khufu. This hope has been, and still is, the impetus for all official explorations in the Great Pyramid.

The tools and methods employed over the past couple of centuries have changed from the aggressive ripping out of pyramid stone by setting off dynamite and attacking the limestone with pickaxes and chisels, as famously performed by Howard-Vyse in 1837, to the more recent, sophisticated muography methods employed by the ScanPyramids mission, and everything in between. When these explorations reached their conclusion and the tools were packed and shipped back to wherever they originated, the search for burial chambers has always come up empty. No burial chamber. No Khufu's mummy. What has been exposed, however, has

been more evidence of the critical functions of this sophisticated precision electron harvesting machine.

THE PYRAMID ROVER EXPLORATION

After *The Giza Power Plant* was released, I, like millions of other Egypt watchers around the world, was waiting for the day when additional explorations would take place and another tantalizing barrier to greater knowledge might be removed. Any news that came from the Giza Plateau I immediately examined and researched. Some information I commented on at the Giza Power website and I also published articles in *Atlantis Rising* magazine. Around that time, there was an inhabitant of Giza who reported on happenings around the plateau. He even set up a camera that was focused on the pyramids and ran a live feed to the internet. With such huge interest around the world and a fledgling online social media capability growing quickly, a live stream of little going on was considered entertainment.

On September 16, 2002, hundreds of millions of people around the world tuned in to watch "Opening of the Secret Chamber: Live!" The FOX network in the US broadcast to 30 million viewers, and in China alone, it was reported that the event attracted half a billion viewers. It had been nine years since Rudolf Gantenbrink made his famous discovery of the limestone barrier at the end of the Queen's Chamber South Shaft. Had Gantenbrink been allowed to continue his explorations after his 1993 discovery and equip his robot to penetrate his "door," as he wanted to, we would have known what was behind it a long time ago. But now, a new robot—aptly named Pyramid Rover—was in town. Built by iRobot Corporation in Bedford, Massachusetts at a cost of $250,000, its stated mission was to drill a hole in Gantenbrink's door, insert a camera, and see what lay beyond.

At the time *The Giza Power Plant* was published, this exploration was not on the horizon, and I had no idea when more information would be revealed, but, anticipating that further explorations would be made someday, I included in the book a prediction of what might be found when the day came. This prediction was based on what is found elsewhere in the Great Pyramid and is an engineering analysis of the function of the pyramid as a machine. The prediction was that behind Gantenbrink's door would be

a vertical shaft that connected with a bedrock chamber beneath the Great Pyramid. The bedrock chamber, I proposed, would house the mechanism necessary to pump chemicals through this supply shaft to the Queen's Chamber shafts to sustain the production of hydrogen for generating maser activity in the King's Chamber. See color plate 17.

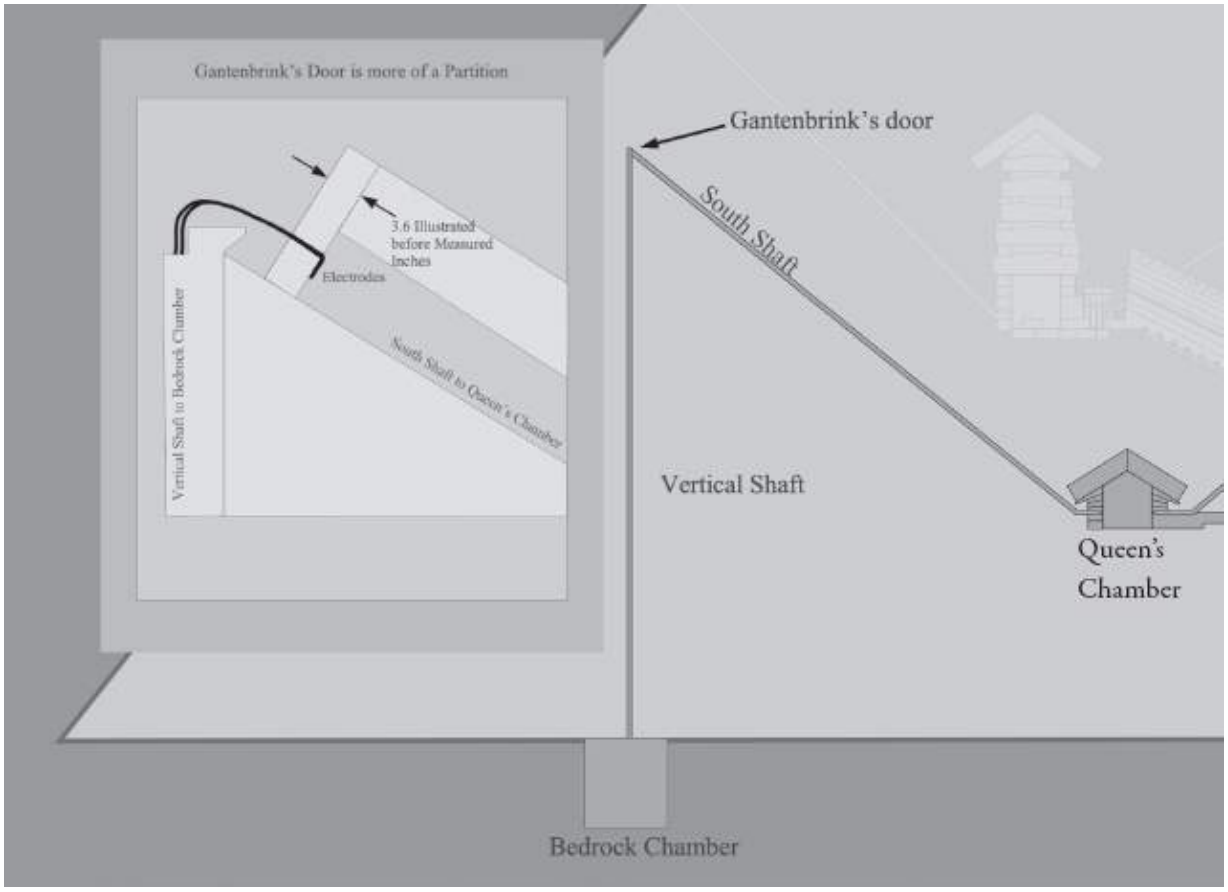

Figure 5.4. Original prediction of what may be found behind Gantenbrink's door.

When I visited Egypt in 2001, after the book was published, I became aware of a feature to the east of the Great Pyramid that seemed to suggest a much better design was used than a vertical shaft. A curious vertical shaft outside the pyramid near the center of the north-south axis caused me to consider that perhaps the chemicals were not pumped from a bedrock chamber under the base of the pyramid but from outside the pyramid, through chemical supply shafts that I proposed were connected to the Queen's Chamber South and North shafts. Logistically, it makes more sense

not to have to go into or under the pyramid to replenish the chemicals. The supply shafts leading from external chemical containers up to the Queen's Chamber South and North shafts could have been included in the construction as the layers of the pyramid were built. Interestingly, this change in design is not the only one that makes more sense than what I proposed in my book.

On September 16, 2002, the exploration of the South Shaft in the Queen's Chamber of the Great Pyramid was broadcast live from Egypt. Before the show aired, a mixture of predictions on what would be found behind the "door" were discussed in various forums, websites, and broadcasts. Most of them were clearly based on the Great Pyramid being the tomb for King Khufu. They included:

- A sacred book written by Khufu would be discovered—perhaps Khufu's diary or guidance on navigating the afterlife.
- A sacred scroll.
- A statue that was positioned to view the stars.
- It doesn't matter what they find. Unless it's an alien spaceship, it will support the tomb theory.
- A space 30 feet (9.14 m) long that contains sacred sand.
- Nothing. Just core masonry.

On September 15, 2002, I openly shared the prediction I had published in my book, with an update regarding the external storage and pumping station, on my website and in radio interviews about what might be found. When George Noory on *Coast to Coast AM* asked me what would become of my prediction if behind the "door" they found scrolls, a statue, or a burial chamber, I responded that this would most likely support the tomb theory and essentially put to rest any arguments to the contrary—including mine.

Figure 5.5. Vertical shaft on east side of Great Pyramid, looking north.

Figure 5.6. Vertical shaft on east side of Great Pyramid, looking west.

Figure 5.7. Vertical shaft on east side of Great Pyramid, looking east.

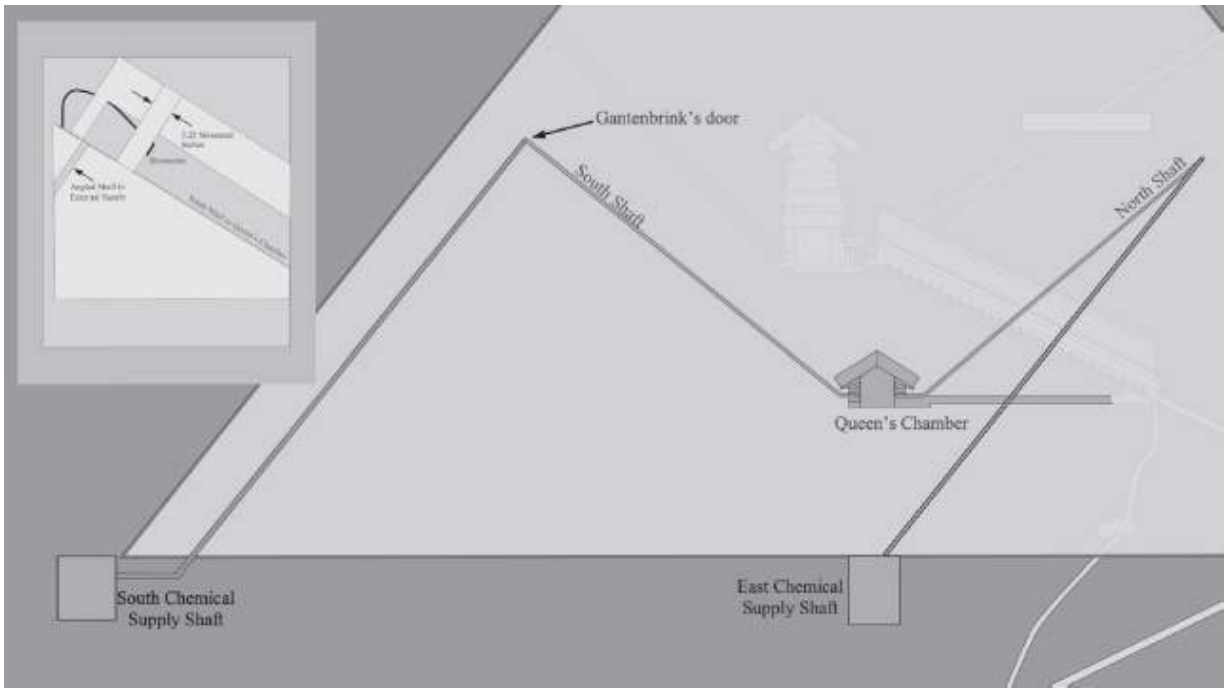

Figure 5.8. 2002 revision of theory to include external shafts.

The two-hour FOX/National Geographic extravaganza provided a breathless prelude to the moment when Pyramid Rover's masonry drill bit finally broke through into the space beyond and the endoscopic camera was inserted into the hole to take a peek at what lay beyond Gantenbrink's door.

The preparatory work was fascinating. With necessary due diligence, the team completed an exhaustive research and experimental period, which included:

- Measuring the thickness of the stone blockage using an impact sensor, which uses reflected sound waves to determine distance. (Before this test was conducted, the right metal pin was shortened to allow the sensor to fully connect with the limestone.)
- Building a replica of the South Shaft on the same angle, including a limestone block with the same dimensions as the shaft and the recently measured thickness.
- Equipping the robot with the correct drill size to drill a hole in the test "door" through which the robot could insert a camera to capture on video what was beyond.

- Hawass and his colleagues observed the drilling of the rock and gave approval for the team to proceed and drill through Gantenbrink's door.

The illustration in my book closely predicted one of the attributes of the "door," and the evidence supported this prediction. In my illustration, the thickness of the block is given, by scale, as 3.64 inches (9.25 cm). My measure was based on nothing more than my proposed function for the block. The impact sensor on the Pyramid Rover measured the actual thickness and found it to be 3.25 inches (8.25 cm) thick. Function = design = measure. And in reverse engineering: measure = design = function.

Hawass's confidence seemed to become slightly muted as the program drew to its climax. He cautioned the viewers that there may be nothing behind the door at all. His prophetic comments became a reality to all of us as the camera with its fish-eye lens pushed through the hole and a distorted image came into view. There appeared to be nothing there but a rough-looking block a short distance away.

After two teasing hours leading up to the actual penetration of the "door" in the last five minutes, images from the camera feed allowed Zahi Hawass, then chairman of the Supreme Council of Antiquities (SCA), to dramatically announce, "It's another door! With a crack!" Not much was said after that except Hawass claiming that it was a very important discovery. In a later interview he advised that "everything now needs a careful look. We will ask the National Geographic Society to cooperate to reveal more mysteries."

ANOTHER "DOOR?"

On September 23, 2002, news came out of Egypt that the Pyramid Rover team had successfully explored the Queen's Chamber North Shaft in the Great Pyramid. This shaft, directly opposite the South Shaft, posed problems for early explorers, who pushed rods into it in an attempt to explore its depth. In 1993, with Upuaut II, Gantenbrink was unable to navigate around earlier explorers' rods that were jammed in the passage as they attempted to push the rods around a bend in the shaft. The iRobot team had a cunning but simple solution to the problem. They turned the robot 90

degrees and sent it up the shaft gripping the walls instead of the ceiling and floor. In this manner, it was able to ride over the top of the obstacles.

The journey the Pyramid Rover took through the shaft was not advertised nor were any details released, except for what was revealed when it reached its destination—another barrier that was similar to Gantenbrink's door, with two metal fittings protruding through it. There are some remarkable differences between the North Shaft metal fittings and the South Shaft metal fittings, though it was still awarded the same description of being a "door," with the exception of not having Gantenbrink's name attached to it.

Within the context of the power plant theory, the existence of these metal fittings is predictable. Also predictable are the characteristics of the fittings. The power plant theory describes a chemical process where two solutions combine to create hydrogen. I had proposed that the South Shaft provided a diluted hydrochloric acid solution to the Queen's Chamber and the North Shaft provided a hydrated zinc solution. The function of these metal fittings was to serve as anode and cathode electrodes, where the flow of electricity from the anode through the liquid to the cathode would create a circuit and allow monitoring of the fluid levels in the shafts. In the Queen's Chamber North Shaft, however, the liquid contains metallic atoms, which would cause electrodeposition on the cathode.

DOESN'T HOLD WATER

There have been objections to the theory that chemicals were being fed through these shafts into the Queen's Chamber. However, I believe that there is more evidence to support the idea than there is to dismiss it. One of the objections, based on what is observed inside the channel, is that some blocks, having shifted, would cause leakage. I would respond that the channels were constructed to pass fluid, not hold fluid. Similar to a storm sewer, leaks may be present, but the bulk of the stormwater is passed through. Also, the seals on storm sewers cannot be seen on the inside, so without knowing how the shaft blocks are fitted, it is not a valid argument.

What kinds of seals may have been used by the ancients? Evidence of plaster of paris has already been noted by Piazzi Smyth. It was also noticed by remote sensing archaeologist Meg Watters. During the filming of the Pyramid Rover's exploration of the South Shaft, in "Into the Great

Pyramid" at timecode 45:05 (National Geographic 2002), Watters noted that mortar appeared to be oozing from underneath Gantenbrink's door. Both Smyth and Watters assumed at first glance that the white substance between the joints of the Queen's Chamber shaft blocks was mortar. Smyth was able to retrieve a sample near the opening of the shaft, and it was determined to be plaster of paris. One can assume that Watters, not being able to retrieve a sample and have it tested, was observing plaster of paris as well. It could be that it was not used to provide mechanical strength to the joint, but to seal the joints and prevent leaks. To my knowledge, nowhere else in the Great Pyramid has plaster of paris been found oozing from pyramid block joints except the shafts of the Queen's Chamber.

Also, the channel block above a recess in the floor of the shaft, which Gantenbrink described as the tank trap, appears to be sitting on a material that is oozing into the space (See "Into the Great Pyramid," timecode 43:00) (National Geographic 2002).

Another objection to my theory is that using hydrochloric acid solution would corrode the limestone. In this case, the reason for opposing the theory is the same evidence I used to support it. The evidence supporting the theory of dilute hydrochloric acid can be seen as erosion on the walls and floor of the shaft. This corrosion obviously occurred after the pyramid was built. The theory proposed in *The Giza Power Plant* also points out that the metal fittings known to exist in the South Shaft, being electrodes that served to signal when the level of chemicals in the shaft dropped below a certain level, had been corroded also. The left electrode, significantly, had corroded so much that a section of it had broken off. Without any means of causing this corrosion, except for a patina that had developed over time, the metal would be just like it was after installation. After examining all objections, it is my contention that the evidence present supports the theory and does not weaken it. There is ample evidence to prove that the North and South Shafts in the Queen's Chamber display characteristics that indicate some action took place in them after they were constructed. Considering that they were intentionally designed and constructed to be closed on both ends and inaccessible from the chamber they are almost connected to, all the evidence points to a fluid being the source of the action. The open question is what chemicals was the fluid carrying and what was the ratio between the chemicals and water?

Hawass had predicted that behind the stone block at the end of the North Shaft would be "another door." With the exception of the nomenclature of "door," on this point Hawass and I agreed. If and when an expedition is mounted to drill through the North Shaft block, most likely another space similar to the one at the end of the South Shaft will be revealed, as well as a chemical inlet shaft on the east side of the cavity, perhaps in the floor but possibly in the east wall. The reason I said this is because of the external vertical shafts on the east side of the Great Pyramid. See the images on pages 134 and 135.

In the power plant theory, every architectural element in the Great Pyramid is integrally linked. Some features can be analyzed separately, but for the most part, the Subterranean Chamber, Queen's Chamber, King's Chamber, and Grand Gallery are the principal features that work together in unison, and they cannot be separated from each other when considering a piece of evidence. Top to bottom, they depend on each other.

The features found in the King's Chamber, mainly the width and height of the North Shaft, led me to propose the use of dilute hydrochloric acid in the South Shaft and hydrated zinc in the North Shaft of the Queen's Chamber. The features in the Grand Gallery led me to understand the function of the King's Chamber. The features in the Queen's Chamber indicate that a chemical reaction could have taken place there to create hydrogen. The hypothesis rises or falls on the evidence found in these areas. For the theory to hold together, evidence discovered in the future has to support it. Some evidence, such as what will be found behind Gantenbrink's door, can be predicted by what is found in the chamber, the South Shaft, and the North Shaft. The power plant theory will be either vindicated or severely challenged or even dismissed based on what is revealed.

My confidence in the validity of the theory may have caused me to jump the gun after the Pyramid Rover expedition and misinterpret what the images revealed. Like everybody in the US, I was watching the video on FOX television. In the top left corner was the word LIVE and the bottom left carried the FOX symbol with Channel 27. There was really nothing for me to become excited about on this broadcast until a man in Germany provided a high-resolution image he had taken of the National Geographic program being broadcast on Sky television in Europe. This image seemed to indicate there was more to be seen in the area occluded by the FOX logo.

I copied the image into a graphics program and auto-adjusted the levels, which lightened the dark areas. I stared for what seemed to be eternity at what was revealed.

I know that if you stare at something long enough you might be able to see a face or some other shape, but the rectangular shape in the left corner of the new block became immediately apparent. I then adjusted the levels, curves, and colors to bring more definition to the image and created construction lines using the bottom corners as guides to create a vanishing point. It was my intention to see if the geometry of the rectangular shape on the left side was indeed a true rectangle parallel with the wall.

I saw what I was hoping to see. A small, dark, rectangular shadow on the floor next to the east wall and the newly discovered "door." I thought the inlet shaft had been revealed, and I published updated drawings incorporating this new "discovery" and promoted the new information on the radio and on my website.

Unfortunately, I was wrong. But it was going to take 10 years before the evidence revealed by the Djedi robot expedition made me realize it. This remarkable exploration will be discussed in the next chapter.

On September 23, 2002, an additional piece of critical evidence was recorded by the Pyramid Rover robot. Unfortunately, this evidence received no attention for almost two decades. Since I began writing this book, numerous events that I can only describe as moments of synchronicity have transpired. The events were beyond my contrivance or control but were critically important to how this book developed and the information it contains. Such an event occurred on July 29, 2021, when I received an email from one of my readers in the UK named Ben Fitzpatrick regarding recent revelations discovered in the North Shaft of the Queen's Chamber of the Great Pyramid. Ben writes:

> Hi Christopher,
>
> I hope you can still be reached here. I've just re-watched Ancient Architect's new video on the Queen's Chamber Northern Air Shaft. "First Look Inside the Great Pyramid Queen's Chamber Northern Shaft"
>
> It contains a revelation, which I don't believe I've seen in your works or diagrams, but which massively supports your Pyramid Power theory, which is that the cathode sits in a little recess in the

> stone rather than protruding from it. I'm no scientist, but I've just looked up recessed cathodes and it apparently helps to prolong the life of the cathode by extending how long it takes for the build-up to occur. This recess combined with their physical appearance is clearly enough evidence to say these definitely are anode and cathode rather than ceremonial plug handles!
>
> Forgive me if this was something you were already aware of.
>
> Cheers,
>
> Ben
>
> (Ben Fitzpatrick, email to author, July 29, 2021)

This was the first time I had been made aware of this. I knew about the pins and the presumed electrodeposition on the cathode, so after watching the YouTube video, "First Look Inside the Great Pyramid Queen's Chamber Northern Shaft" (Sibson 2021) referenced by Ben, I contacted the owner and content creator, Matt Sibson, and we had a very cordial conversation. As I was in the early stages of writing this book, I was curious about copyright permissions and where he had received his. He told me that he had received images and two articles from an ex-employee of National Geographic and was using them for educational purposes, so no release was asked for or obtained. For my purposes, I will not include the photographs here, but will refer the reader to the Ancient Architects video (Sibson 2021) and the relevant timecode of interest (timecode 10:08) and include a drawing of the feature being discussed.

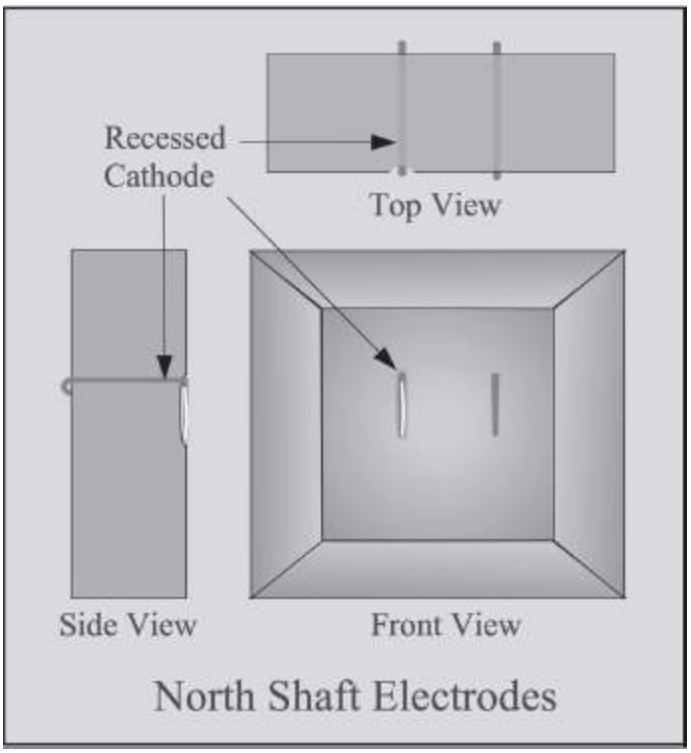

Figure 5.9. North Shaft plug with recessed cathode.

Earlier, I mentioned paying little attention to what appeared in the camera's frame as the robot progressed along the shaft toward its destination. In both the North and South Shafts, the destination was the place where the shaft ended. In the case of the South Shaft, that point was already known, whereas it was still a mystery in the North shaft.

What Sibson had received from his contact were 51 images taken by the Pyramid Rover as it climbed the North Shaft seeking the termination point. This exploration took place in the weeks following the broadcast of the drilling through Gantenbrink's door and was not given the same attention. Nonetheless, what was revealed from this exploration was another blockage with two metal pins similar, but not identical, to those installed in Gantenbrink's door. It was the nature of this blockage and the pins that prompted Ben Fitzpatrick to contact me.

While some of the photographs appeared in a journal article authored by Zahi Hawass that was not widely distributed among the public, Matt noted in his video that there seemed to be a lack of inquisitiveness about the anomalies seen in the photographs.

As I had already commented on the Giza Power website about the appearance of these electrodes in the North Shaft and concluded that the cathode appeared to have been electroplated, Ben's additional observations that a recessed electrode extends its life were just additional support. Interestingly, while most likely not even considering the electrical nature of this discovery, Zahi Hawass had commented on this feature in an article entitled "The So-Called Secret Doors inside Khufu's Pyramid."

> At 209 feet (63 m) in the northern shaft (QCN) we discovered a third blocking stone; this closely resembles the first blocking stone in the southern air-shaft (QCS) (Figs 13, 14 and 15). As on the first stone, there were two metal pins protruding from the stone, which are covered with a green patina. The left pin is recessed in a grooved cut in the door and thus sits flush with the surface of the stone. The second pin is bent down on to the surface of the stone itself. The stone appears to be supported by the wall blocks as in the South Shaft. The thickness of this block is not known. (Hawass 2014, 51–68)

In the video, Sibson rightly points out that any theory about the function of the Great Pyramid has to logically be able to explain all evidence found within. I made a similar comment in *The Giza Power Plant*. Also, following the scientific method, if new evidence is found, the proposed theory has to accommodate and explain it. If the theory cannot do that, then the theory cannot stand. New evidence cannot be dismissed or ignored.

There is now no doubt in my mind about the electrical function of the metal pins in the Queen's Chamber shaft. The North Shaft barrier had received extra attention and detail, with a groove being cut into it so that the metal pin at just this location can be recessed from the surface of the stone. The metal pin so fitted is the only pin that has a material deposited on it.

The exploration of the North Shaft and what was discovered at the end were predictable and, to my mind, vindicate the purpose for these shafts as outlined in *The Giza Power Plant*. The image of another "door" with metal fittings and the subtle difference between these fittings and those at the end of the South Shaft support the hypothesis regarding the chemicals used. The electrodes are affected by different chemicals in different ways. In the

South Shaft, the action of the dilute hydrochloric acid eroded the copper over time. Because the upper part of the copper was covered with chemical for a shorter period of time than the lower part, as the fluid was always falling, the lower part of the copper was eroded more than the upper part. This resulted in a tapering of the copper and the ultimate failure of the left electrode. In the North Shaft, we see a different effect. Because this shaft contained a hydrated metal, such as hydrated zinc, what we see is an electroplating of the anode. In the photograph taken by Pyramid Rover, there is a white substance on the left electrode only. Unlike the electrodes in the South Shaft, there is no erosion on these electrodes and the pins appear to be less thick than those in the South Shaft. Notice also the stained limestone to the left and on top of the electrode.

LOCATION OF THE CHEMICAL INLET SHAFT

I don't want to misidentify a feature again, as I did after the Pyramid Rover Expedition in 2002, but I have to point out that the visuals and surrounding evidence provided by the Pyramid Rover revealed a surprising location where the chemical inlet shaft connects with the North Shaft. In both the South Shaft and the North Shaft, I had assumed that the chemicals entered the shafts at their upper ends, behind the so-called door. I didn't expect to find that the inlet would be lower down the shaft but, considering that a lower connection would be closer to the supply on the outside, it now makes perfect sense.

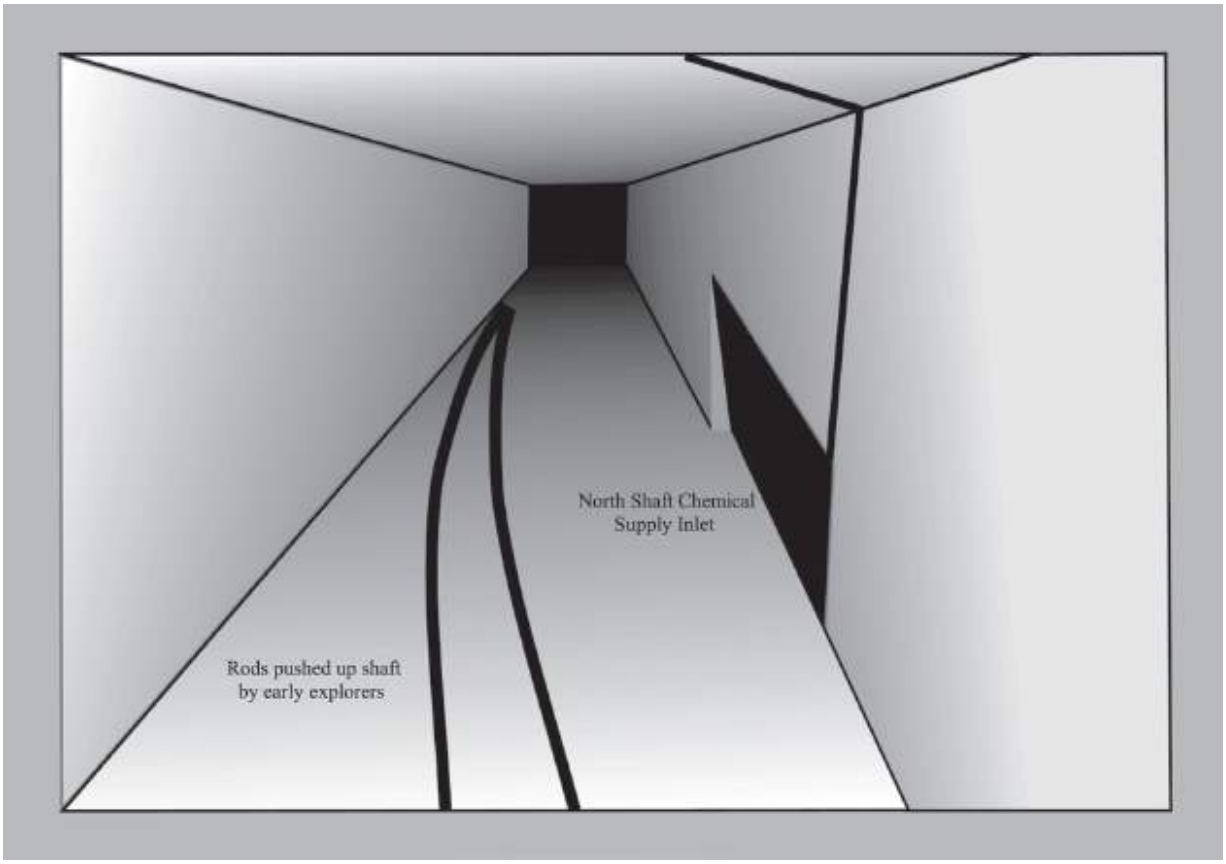

Figure 5.10. Opening in Queen's Chamber North Shaft.

I am now faced with accommodating new evidence and revising my theory again, as the photographs reveal that to all appearances the shaft supplying the chemical to the Queen's Chamber North Shaft is located approximately 96 feet (29.26 m) from the opening of the North Shaft in the Queen's Chamber. I highly recommend that the reader watch the video on the Ancient Architects channel that I referred to above at timecode 10:08, where this feature can be seen on the east wall on the second bend of the shaft.

Opposite the opening there is a collection of trash from where Pyramid Rover retrieved crumpled paper and a site ticket. The site ticket was dated to the 1970s. It is old, but certainly not as old as the pyramid. How did these items get there? It has been speculated that they were introduced into the shaft when the opening was cut after the pyramid was built. My belief is that the opening is part of the original design of the machine and its placement makes it closer to the vertical shafts located outside the Great

Pyramid on the east side near the center of the north-south axis, as seen in Figures 5.5, 5.6, and 5.7. Also, as the photograph of this opening shows, the collection of trash is to the left of the rods that were jammed in the tunnel, while the floor in front of the opening appeared to be swept clean. It would seem that a strong wind had carried the trash up the shaft from the outside.

Looking at the photographs of these exterior shafts, we see a vertical shaft cut into the bedrock that has a center wall, creating two shafts approximately three to four feet from the top. If you look down into the shafts, there is trash, blown sand, pop cans, candy wrappers, cigarette butts, pieces of paper, and perhaps a site ticket or two. Also, what would we find if we removed all that trash and sand? How deep does it go? What would we find at the bottom? In 2001, I was shown a vertical shaft, south of the pyramids but a large distance away, that was being cleaned out. At that time, they had reached 100 feet (30.48 m) into the bedrock.

The external shaft seems to be a logical source for the miscellaneous collection of trash. It gathers opposite the opening of the inlet shaft, and some of it slides down the shaft and accumulates. How else would this collection of garbage have got in? The trash could not have come from the upper section of the North Shaft, and it's doubtful that it was carried into the Queen's Chamber and pushed up. The most likely means is that it was blown in by a sandstorm. Maybe an energetic explorer who discovered an opening on the outside started pushing up rods of steel or wood, but I doubt it. It's significant, also, that the floor in front of this opening is seemingly swept clean of debris and sand. This is probably the result of an occasional strong breeze wafting through.

Many questions are left hanging, but the main one at this time is if a connection exists between this external shaft and the North Shaft, where is the opening on the outside? The wall of the shaft closest to the pyramid does not seem to match the bedrock around it, and there appear to be unnatural separations with the adjacent shaft walls, which are clearly cut through bedrock. Was the west wall of the external shaft plastered over at some point?

I had identified this shaft on the outside as the place where chemicals were stored and delivered to the Queen's Chamber shafts. In 2002, I posted an article on my website illustrating this. The newly discovered location of the chemical inlet shaft into the North Shaft makes perfect economic sense, considering that the distance would be shorter than if the inlet shaft was

behind the blocking stone. Considering that the North Shaft is approximately 8 inches (20.32 cm) square, the dimensions of the inlet shaft would be about 2.5 inches (6.35 cm).

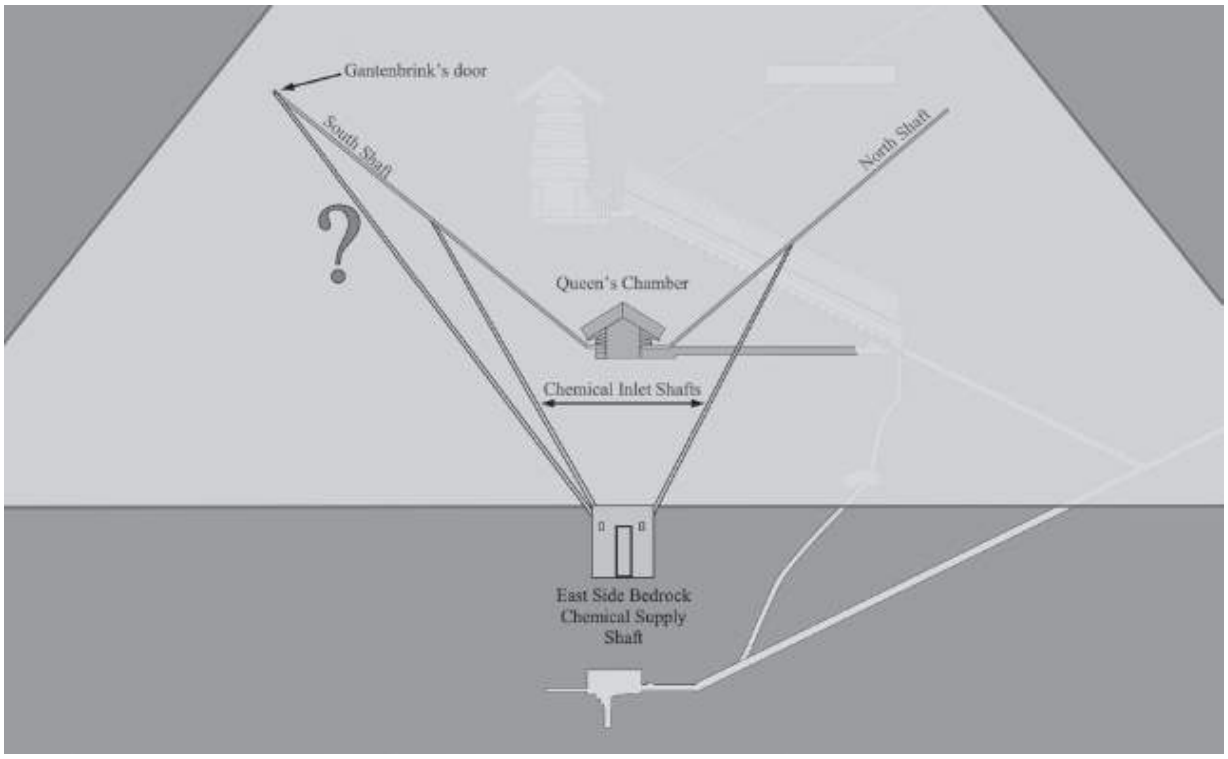

Figure 5.11. Revised 2022 drawing. External bedrock shaft shown greater than scale for clarity.

A useful experiment would be to install in the opening of the North Shaft in the Queen's Chamber a watertight seal that has a hose connector and pump water into it. As the shaft fills, monitor the vertical shaft on the outside to see if it starts showing signs of being saturated or filling with water. Simple test. No robots and very little money. The Queen's Chamber South Shaft still holds the mystery of where the inlet shaft will be found, but it would be useful to conduct the same experiment there too. However, there is an area farther down the shaft from Gantenbrink's door that deserves closer examination.

Following the Pyramid Rover's exploration of the South Shaft and what it revealed about the "door" and what existed beyond, a part of my prediction was proved correct, but other parts were inconclusive. The part that was correct was the function-driven design of the "door," its pins, and

the space behind it. The parts of my prediction not proven were the continuation of the pins and any connection they may have had to electrical wiring. Inconclusive also was the existence that I had predicted of a chemical inlet shaft behind the door.

But after what has recently been revealed to a larger public (i.e., the possible existence of an opening lower down in the North Shaft, which I have labeled the chemical inlet shaft), attention should also be given to the possibility that an opening lower down in the South Shaft has previously been overlooked. As I said earlier, with everybody's attention being focused on the destination, much of what exists along the journey has been ignored.

THE PESKY TANK TRAP

Tank traps are used during wartime against enemy tanks. A trench is dug in the ground and camouflaged with brush. The unfortunate tank that travels across this particular section of terrain will find itself crashing through the brush and ending up nose first in the ground, unable to move in any direction. While the builders of the Great Pyramid were not expecting tanks to be moving about in their structure, a feature that is found in the South Shaft was named a tank trap by Rudolf Gantenbrink after his robot Upuaut II found its treads bumped up against a ledge and was unable to navigate further. Gantenbrink's robot found itself in a place in the floor of the shaft that is about two inches (5.08 cm) lower than the rest of the shaft's floor. Not only did Upuaut II have difficulty traversing the tank trap, but in 2002, Pyramid Rover got trapped there also. In both cases, a makeshift bridge was crafted and installed in the shaft so the robots could ride over it. The features of the tank trap can be seen in the video "Into the Great Pyramid," timecode 43:00 (National Geographic 2002).

The only view of the tank trap is from the robot's front camera. A recess in the floor is seen that appears to have been cut intentionally, like a channel through the floor block, except, unlike the channel cut through the block that creates the walls and ceiling of the shaft, this recess is rough cut, and only two inches (5.08 cm) deep. There has not been any discussion about this feature, but it was clearly added to the structure while it was being built and not afterward. I confess to having been puzzled by this recess. At first, my impression was that it was due to erosion and that this stone was, for some reason, more susceptible to the corrosive action of the chemical in the

shaft. If that is the case, why just this one block? It also occurred to me that perhaps it was the result of the floor block shifting downwards. But that can't be the answer because the depth of the recess does not reach under the upper channel block but is clearly rough cut, leaving the original upper surface to support the upper block.

Like the South Shaft and North Shaft, the "tank trap" deserves a much closer examination to see if a focus on the destination has missed some critical features along the way.

Perhaps when all the blocks that comprise the South Shaft were installed there was supposed to be a slot cut in the upper block similar to that in the North Shaft. Absent this necessary feature the builders found it more convenient to cut a recess in the floor with an opening in the side that would connect with the chemical supply shaft.

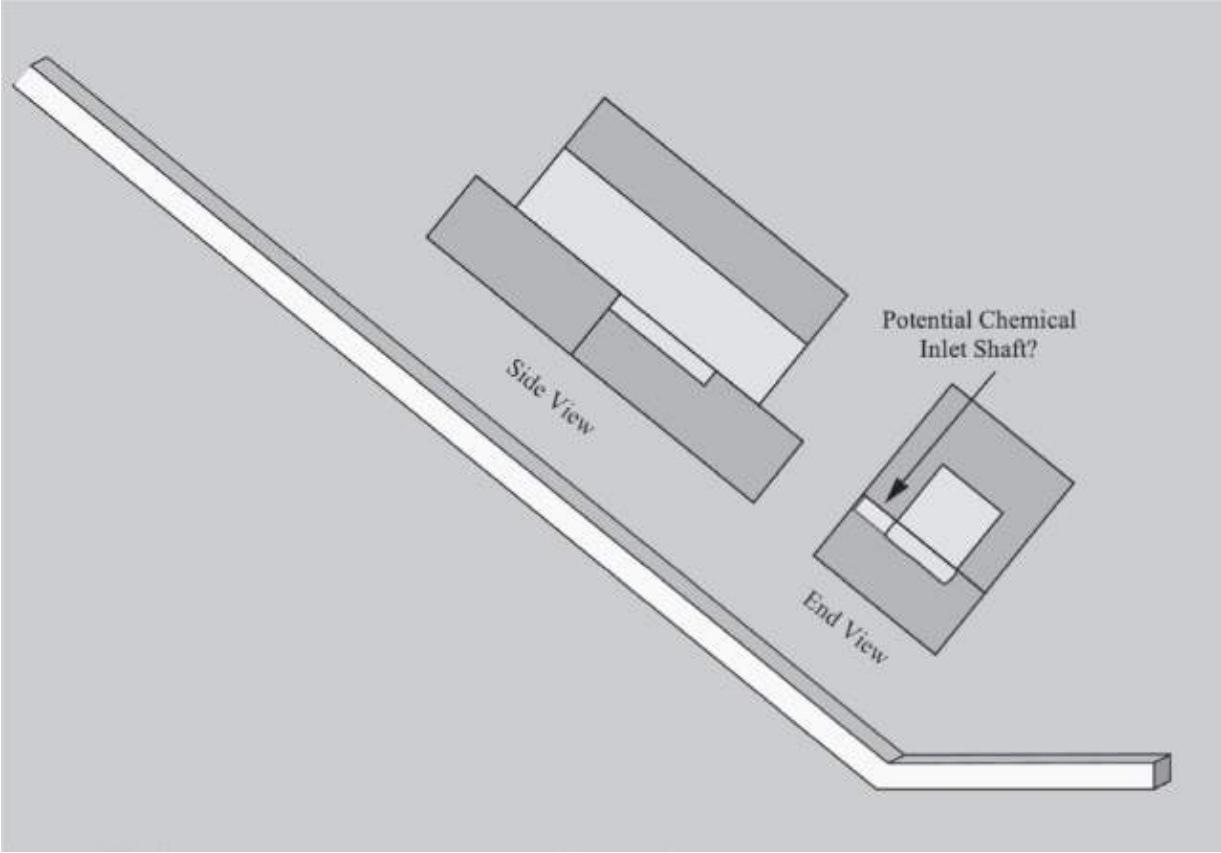

Figure 5.12. Details of tank trap in South Shaft.

Yes, it is speculation, but the fact remains that this feature exists. It is not the result of the bottom floor block shifting downward after it was installed, or caused by erosion. No similar erosion exists elsewhere in the shaft, and the shaft channel block is resting on the bottom block's surfaces that lie outside the width of the recess cut in the bottom block. It was intentional and therefore there must have been a reason for it. Interestingly, the quality of the cutting appears to be identical to the cuts in the North Shaft on the wall near its chemical inlet shaft.

Up until now there has been, as Matt Sibson pointed out about the Queen's Chamber North Shaft, a lack of inquisitiveness regarding what is revealed along both journeys to the prized destination—the infamous "doors." In the next chapter, another expedition explores the Queen's Chamber South Shaft and reveals even more details to puzzle over.

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*"Noisome" means offensive to the point of arousing disgust; foul.

SIX
ENTER THE DJEDI

Be an opener of doors.

RALPH WALDO EMERSON

ANOTHER LOOK BEHIND DOOR NUMBER ONE

It wasn't long after the buzz surrounding the Pyramid Rover expedition inside the Great Pyramid had died down that the world's attention was drawn to the announcement of another expedition that put a different spin on challenges faced by previous robots. This expedition would involve a newly formed team using a different type of robot to explore the Queen's Chamber South Shaft.

As long as the search for Khufu's burial chamber continues, more parts of this energy machine are revealed, which, for me, is a good thing. However, those who were involved in the design and building of the pyramid would probably be quite amused that someone in the future would speculate that behind a blocking stone at the end of a long square shaft that would only allow the passage of a small rodent or robot would be a burial chamber.

THE DJEDI, THE DENTISTS, AND THE PYRAMIDS

There is something about the pyramids that seems to fascinate dentists. Two of my dentists, Dr. Randy Ashton and Dr. Michael Fuesting, have both demonstrated a keen interest in them and the work I have been doing for many years. In fact, Dr. Ashton accompanied me and two other friends to Egypt in 2008.

The Djedi robot expedition was the brainchild of a persistent dentist from Hong Kong, Dr. T. C. Ng, who had made numerous visits to Hawass's office at the SCA to convince him to approve another expedition up the Queen's Chamber shafts using a different type of robot that had more capability than Pyramid Rover. In an interview for a documentary chronicling the expedition, Ng said:

> I went to Egypt with no appointment. From nowhere you come, a Chinese dentist, knocking on the door of Dr. Hawass and ask him to give me the opportunity soon to organize a team. I said, hello Dr. Hawass, I'm from Hong Kong, you know, only his mind is probably, you know, look, another tourist. He nearly pushed me out, you know. But, I'm a very persistent person. Dr. Hawass had many offices. I knock on the door of this one. Knock on the door of that one. No one would go there 400 times. But I'm that kind of person. And finally, he could see my passion. Never give up! (See "The Robot, the Dentist and the Pyramid: Ancient Egypt Documentary (2020)," timecode 15:52, on Ancient Architects) (Sibson 2020)

Note: Following this clip, others that immediately follow will be from the same video but I will just list the timecode.

It was decided that a competition would be held between two teams, one from Singapore and one from Leeds in the UK, who would demonstrate the operation of their robot in a test shaft that was built out in the desert. A group from the Faculty of Engineering at Cairo University; Ali Radwan, a professor of Egyptology at Cairo University; Sabri Abdel Aziz, head of the Pharaonic Sector of the SCA; and Hisham El Leithy from the SCA were assembled to supervise and witness the competition.

One of the criteria for succeeding in the competition was that the robot would not leave any traces along its path traveling up or down the shaft. The previous robots had tracked mechanisms for movement, like those of a tank or a bulldozer, and had left scratches on the shaft walls and ceiling. The successful robot, Djedi, built at Leeds University under the direction of Professor Robert Richardson and Shaun Whitehead, was able to demonstrate a different mechanism that left no marks. Rather than gripping the ceiling and floor with track-like mechanisms, Djedi's motion was

provided by employing mechanical actuators with rubber caps on the end on both sides of the front and back carriage. With the front actuators extended and gripping the walls and the rear actuators retracted, a gear known as a pinion that is meshed with a linear gear known as a rack rotated and advanced the rear carriage along a precision linear rail, similar to those used in machine tools, thus closing the distance between it and the front carriage. When the extent of its travel had been reached, the rear actuators were engaged and the front actuators retracted, after which the pinion gear reversed direction and the front carriage was pushed up the shaft.

A modern example of the use of a rack and pinion is the steering wheel in a car. When the steering wheel is turned, a pinion causes linear motion of a rack to push or pull the linkage that is attached to the front wheels, causing them to turn in one direction or the other.

In the same documentary in which Dr. Ng appeared, Shaun Whitehead gave an interesting perspective on the significance of the Queen's Chamber shafts, using models to illustrate his point. His first model was a gray foam wall block with the shaft cut completely through a corner of the block.

Holding the model, Whitehead says, "If I was to walk into an ancient room and find a hole in the wall, even if it disappeared up into the heights of the pyramid, that wouldn't be exciting."

Whitehead then picks up a small rectangular piece of the same material type as the model wall block he was holding, places it in the corner of the model at the beginning of the shaft and says, "If I walked into a room and found there was a block covering this hole that I could easily remove, then that would be a bit more exciting."

Whitehead then picks up a different model with the chamber wall facing the camera, so that there is no indication of a shaft. At the same time, he rotates the model, showing the details of the shaft cut through but stopped five inches (12.7 cm) short of the inside wall, and says, "But if I came into the pyramid and I found that it appeared to be solid and only later discovered that it was hiding a shaft . . . that's very exciting. So somebody has gone to an awful lot of work to cut away this section of block, while leaving some material to hide the shaft. So, the question is, why hide this shaft when a human being can't fit up it?" (timecode: 7:56)

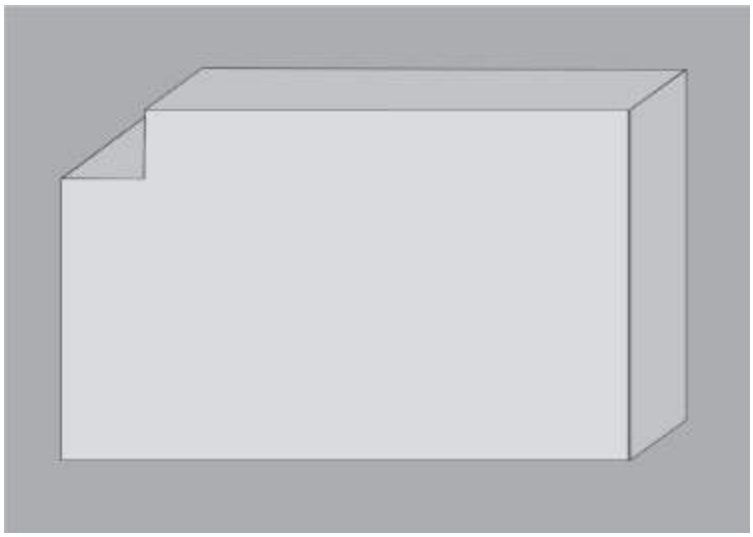

Figure 6.1. Whitehead model A.

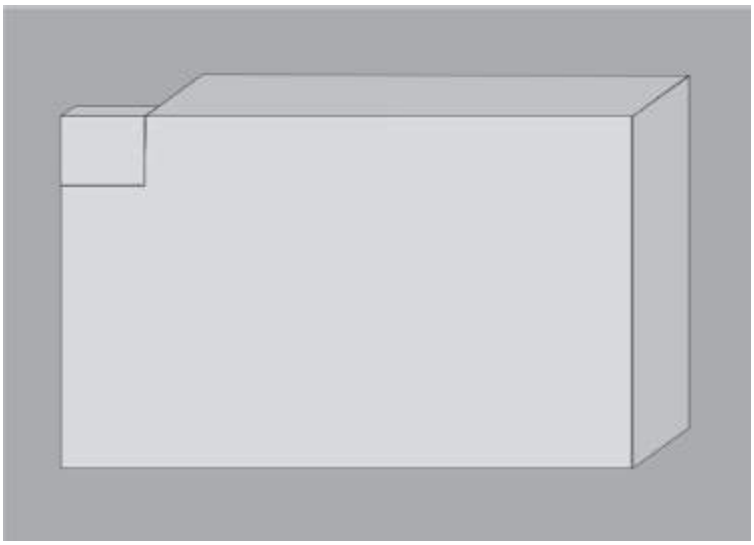

Figure 6.2. Whitehead model B.

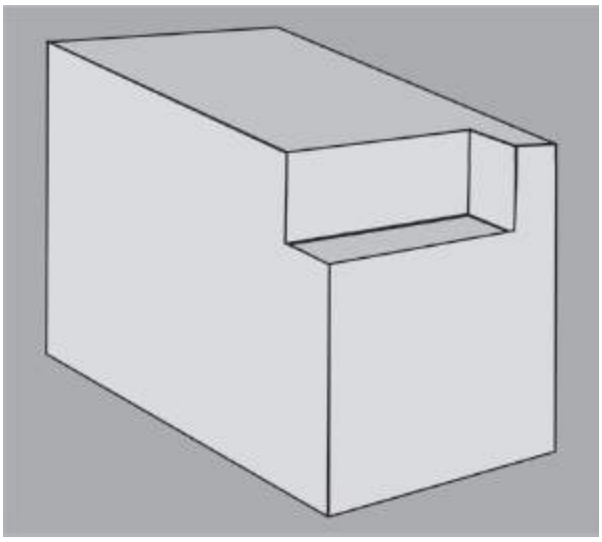

Figure 6.3. Whitehead model C.

The answer to Shaun Whitehead's question is that the designers and builders of the Great Pyramid were not hiding these shafts. The termination at the Queen's Chamber end of both shafts was a crucial part of the design of the system. As were the so-called doors at the upper end of the shafts. Without these features being there, the Queen's Chamber would not function as intended.

The Djedi robot was equipped with a camera that had the ability to rotate and look in different directions, even to look behind itself and capture images of what is behind Gantenbrink's door. The images captured by the Djedi camera provide even more confirmation for my theory regarding the purpose of these shafts. The pins were first discovered by Rudolf Gantenbrink in 1993, but how they were fitted in the door was beyond Gantenbrink's ability to reveal, as well as out of reach of the Pyramid Rover's lights and camera in 2002. The image of the back of the door is incredibly revealing and unexpected.

The Djedi team explained what their robot revealed, to the best of their ability, in a documentary of the expedition that was produced later. Shaun Whitehead is the camera designer from the company Scoutek in Melton Mowbray, UK, and Robert Richardson is an engineering professor specializing in robotics at Leeds University. Their comments on the significance and meaning behind their discovery start at timecode 37:34.

WHITEHEAD: There were beautifully made loops on the back of the stone, which helps us try to work out what they were there for.

RICHARDSON: So, we were able to look around and see that it was a fully enclosed cube space. There was no shaft going off to the left or right, for example. And it was probably the floor that was most interesting.

WHITEHEAD: We were looking at red ochre marks that were not natural. The red markings are an enduring mystery. And opinions have ranged from over a wide variety of meanings. And that's part of the excitement. There's still more to discover. There's still more to learn. And the shafts and the marking are very much a part of that.

RICHARDSON: We have discovered a cuboid space, around 200mm × 200mm × 200mm. Experts in Egyptology, anthropology, symbolism, civil engineering, religion, members of the public have all looked at the findings. Nobody is sure what the red markings mean. Nobody knows why the small chamber was hidden behind the blocking stone, and nobody knows what the pins, loops and blocking stone are for, and nobody knows why the shaft entrance at the bottom was hidden.

On May 25, 2011, an article describing the Djedi robot's images was published by *New Scientist*: "As the camera can see around corners, the back of the stone door has been observed for the first time, scotching the more fanciful theories about the metal pins, says camera-designer Shaun Whitehead of the exploration company Scoutek, based in Melton Mowbray, UK. "Our new pictures from behind the pins show that they end in small, beautifully made loops, indicating that they were more likely ornamental rather than electrical connections." (Hooper 2011)

The article in the *New Scientist* magazine varies slightly with Whitehead's version presented in the documentary. It's a small difference, but holds significance to me because it indicates that the Djedi team knew about the theory that the pins were electrodes, and as I am the originator of that theory, it behooves me to respond to its dismissal by Whitehead by pointing out the following:

The metal loops can be seen to reenter the stone a slight distance below where they emerged. The features of these metal loops at the back of the "door" are consistent with the appearance of electrodes in a battery. It

appears, also, that the pins have a ring of insulation around them, with the anode (the one on the right when looking from behind the door) seemingly less affected by chemical reaction. This ring of insulation is also evident on the front of the door.

Questioning why these electrodes are insulated from the limestone, one possible answer could be that if the limestone door became saturated with chemical, electrical flow through the saturated stone from one electrode to the other would be prevented. If the electrodes were not insulated, when the fluid level in the shaft dropped, the circuit may not have opened until the limestone had dried out.

A significant detail to highlight is the difference in the condition of the pins that are visible from inside the shaft from the condition of the metal on the back side of the blocking stone. I would argue that when these pins were first installed in the door, the condition of the metal visible from inside the shaft and behind the block looked the same. They were straight and round when first installed, but as time and use took its toll, the electrodes serving their purpose began to corrode due to the rise and fall of a corrosive liquid. This resulted in a taper to the pins that reflected the length of time the pin was immersed in fluid. The corrosion was less at the top of the pin, as this area was not submerged for the same amount of time as the bottom of the pin. See color plate 19.

Assuming we accept that chemical corrosion caused the pins in the South Shaft to wear in the way they did, a logical question would be, how long would it take for these pins to wear away and need to be replaced? When Upuaut II provided us with images for the first time of the condition of these pins, the one on the left had eroded to the point that a section of it had broken off and was lying on the floor of the shaft. This was not the result of any human intervention; the metal had failed and a section had broken off through being subjected to a corrosive chemical over time. The pin on the right was still intact and remained so until the Pyramid Rover expedition in 2002. Nothing was mentioned about it, but Pyramid Rover's first images of the door showed that it was the same as when Upuaut II photographed it. However, when the echo impactor, used for measuring the thickness of the door, was mounted on the robot and it returned to the door, the right pin was shortened and the echo impactor was able to fit beneath the shortened pin and press against the door. The phrase "Asking for

forgiveness is sometimes more productive that asking for permission," comes to mind.

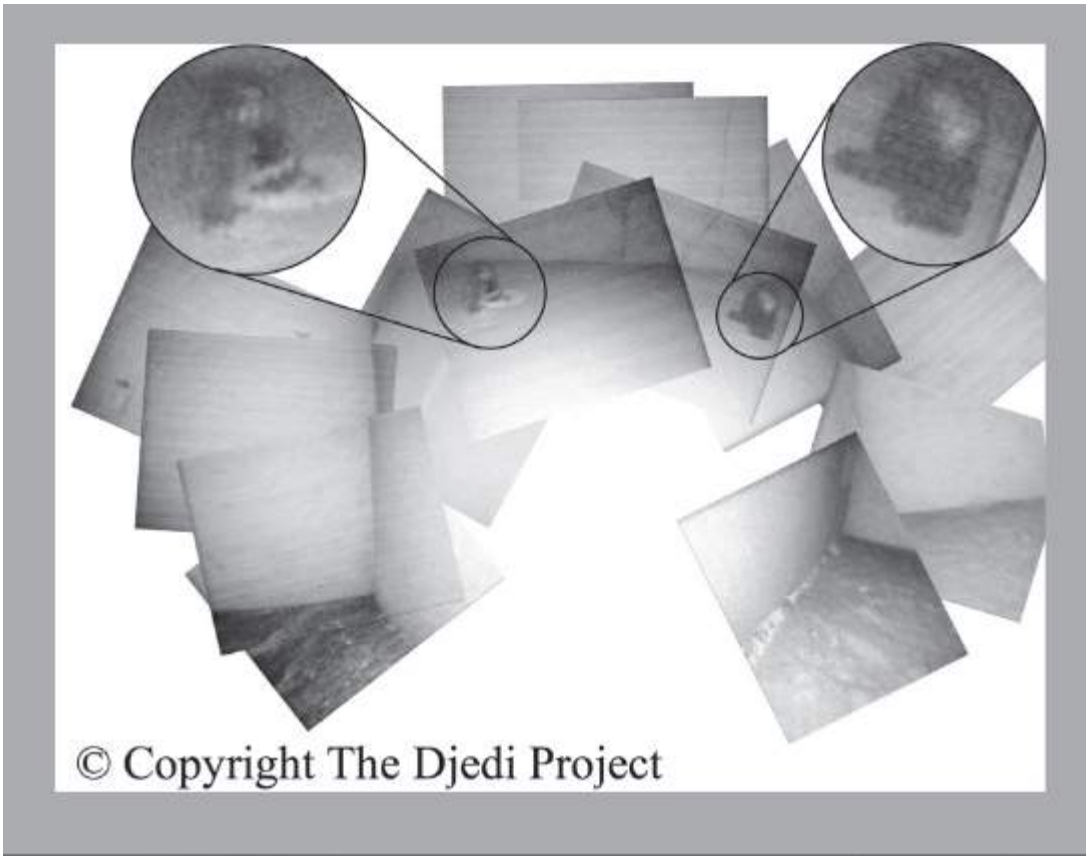

Figure 6.4. Patched image from behind Gantenbrink's door showing the looped pins on the back.
Image credit: Robert Richardson, PhD (the Djedi Project).

MASONS OR MAINTENANCE ELECTRICIANS?

The continuation of the pins on the back side of the blocking stone was not the only discovery captured by the new robot. The Djedi robot also transmitted images of symbols and a line painted in red on the floor behind Gantenbrink's door. Peter Der Manuelian, an Egyptologist at Harvard University and director of the Giza Archives at the Museum of Fine Arts, Boston, said, "Red-painted numbers and graffiti are very common around Giza. They are often masons' or work-gangs' marks, denoting numbers, dates, or even the names of the gangs" (Hooper 2011).

Regarding the marks pictured in Figure 6.5, I propose that we look at them not as mason's marks, but as electrical symbols indicating the polarity of the electrodes (the red line) and the wiring of the electrodes.

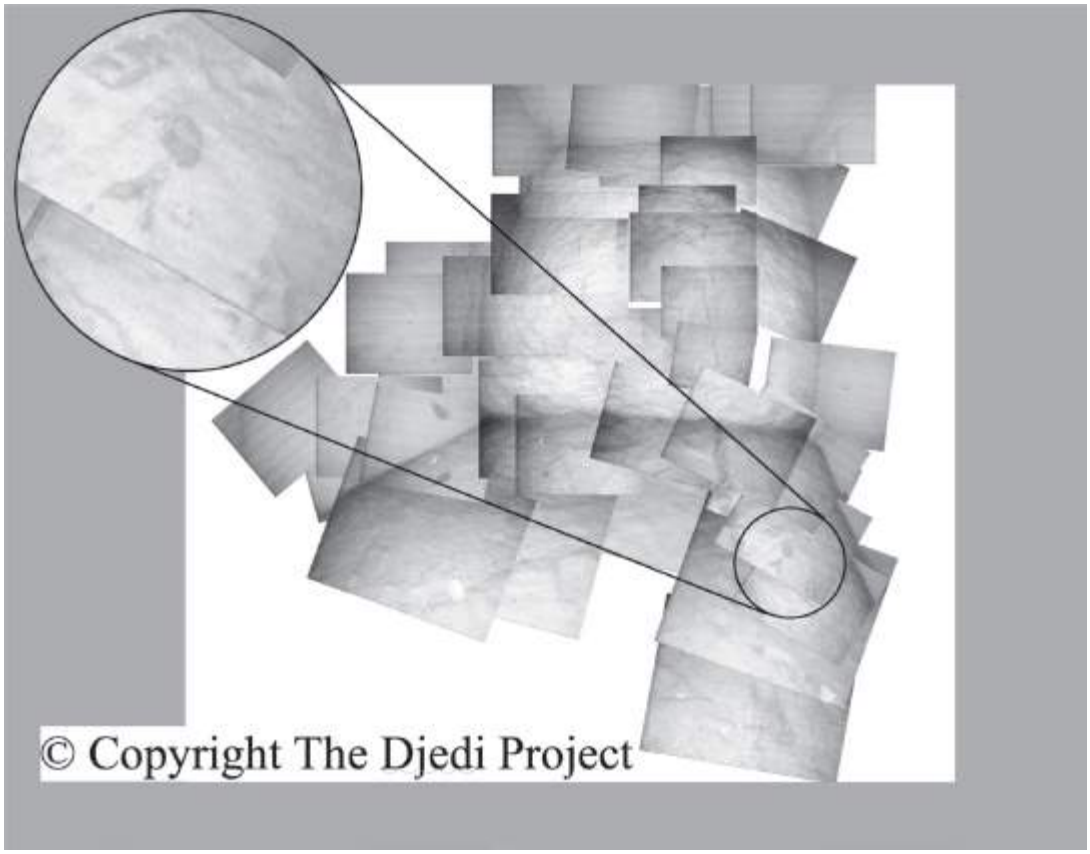

Figure 6.5. Patched image from behind Gantenbrink's door showing the symbols and a line painted on the shaft floor.
Image credit: Robert Richardson, PhD (the Djedi Project).

- The upper symbol appears to be shaped like the number 5.
- The center symbol that shows a round circle with a forked line below it could represent a cable with a twisted pair of wires that separate in order to be connected to a positive and negative electrode. It is positioned between the upper and lower symbols on the floor.
- The lower symbol is roughly similar to the upper with the exception of the top bend, which could go right or left, as when installed it wouldn't matter which way the loop was turned.
- All the symbols, including the line (which would logically represent the main cable coming from the USO) were more than likely

positioned on the side that would identify the positive electrode. This is supported by the appearance of a greater amount of corrosion on the loop on the side where the symbols appear.

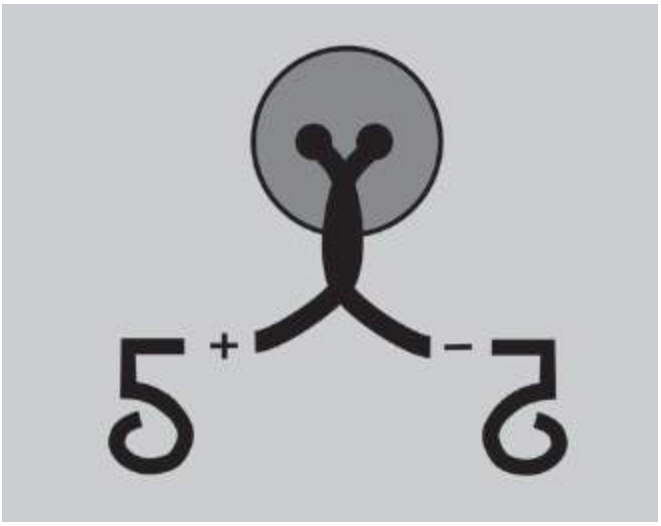

Figure 6.6. Cable with two wires to connect with contacts around metal pins.

When they were discovered, there was no immediate explanation for what these red symbols meant, but they are a significant discovery and have the potential to open an entirely new area of research in gaining an understanding of ancient Egyptian engineering symbolism. When considered along with the metal pins, the symbols provide a tantalizing possibility for how they might have been used to guide a maintenance worker. They explain the electrode use of the pins, and give us, I believe, motivation for further exploration in the future. The ancient Egyptians left us with the physical evidence that supports such an endeavor by providing us with an electrical schematic that showed how Gantenbrink's door and, most likely, the North Shaft "door" metal pins were wired. Even this evidence, existing in a small hollow within the mass of pyramid stone, far removed from other features, is connected to them and critical for the electron harvester's operation.

The images clearly show that the builders were aware that the pins would have to be replaced periodically and had made accommodations for performing maintenance on them. The quickest and most logical way to do that would be to create another blocking stone identical to the one currently

installed, complete with new uncorroded pins and connectors, then remove the existing block and install the new one. After the exchange, the new one could be rewired according to the electrical symbols painted on the floor.

While it appears that the maintenance crew did not clean up after performing repairs in the space behind Gantenbrink's door, the debris was not the only evidence they left there. They also left instructions on how to wire the pins. The pins were probably tapered at the end, which allowed them to enter the 5-shaped loop and push it open so that the loop gripped the pin. The vertical leg of this connector is not to scale (as very few wiring diagrams are) but the actual connector probably had a longer vertical leg up to the point when it is bent at right angles toward the center of the block.

To test my theory regarding the pins in Gantenbrink's door serving as a fluid switch in the Great Pyramid electron harvester, I created a model out of plexiglass and equipped it with electrodes that had a loop on the end. The process included creating a straight pin, forming the loop, inserting the straight pin through a hole in the door, and seating the loop end into a blind hole. Following that and using a torch to heat the copper, I bent the pins down 90 degrees against the door.

Judging by the amount of force I needed to bend the copper pins I had made for my model, it is now obvious that the thickness, or diameter, of those in the pyramid's South Shaft would have to have been substantially larger when originally installed. Considering that the left electrode had failed during use and a section of it broke off without, presumably, human intervention, it would not have survived the force necessary to bend it when it was first installed in the "door." Without wear or corrosion, they would not have broken after use or, as observed, during the iRobot expedition before the blocking stone's thickness was measured.

Figure 6.7. Construction and successful test of Gantenbrink's door model.

When everything was assembled, the ancient Egyptians' level of design sophistication immediately became apparent. Once the pins on the shaft side were bent by 90 degrees with the looped end inserted into the hole, the pins were locked in position and could not rotate.

The most important discovery is the design of the two pins. Judging by their relationship to the size of the space, the pins are approximately $^{5}/_{16}$ inch (.8 cm) in diameter. Figure 6.4 shows the metal looping around, with an apparent gap where the loop on the right pin seemingly disappears into the limestone block. The left pin shows signs of corrosion, similar to those in the main shaft, though not as severe. There also seems to be a white deposit around the left pin and its hole, while the right pin has what appears to be a black ring encircling the hole that penetrates through to the main shaft.

What was revealed by the Djedi robot describes an electrical device that was accessible to workers for maintenance. Considering the erosion on the pins in the main shaft (the negative electrode having broken off in antiquity) and considering the extreme tapering that was more than likely caused by

the rise and fall of a corrosive liquid, another significant conclusion is that these electrodes must have been replaced periodically. At the same time, the electrical cables were probably replaced, and some of the shielding was left in the space. The pins were made so that they could be removed easily and others put in their place. However, a more efficient method would be to have a replacement block with new electrodes already fitted to drop into place after removing the existing one.

I should note here that, as with the entry location of the chemical supply shafts, my design for the wiring of the Gantenbrink's door electrodes is speculative, and, similar to the location discovered in the Queen's Chamber North Shaft, when future expeditions are able to access and physically examine the area around the electrodes, they may find a completely different design. Whatever that design turns out to be, I have no doubt that it will make sense.

From the buildup of salt on the walls of the Queen's Chamber—up to one inch (2.54 cm) thick—to the design characteristics and other evidence discovered in the shafts, to the "noisome odor" assailing early visitors, everything about this chamber speaks of chemistry. Whether the chemistry is that of Drejewski, Cohen, or another preferred formula, there is no denying that only when analyzed through the prism of chemistry do we start to reveal answers to a millennia-old mystery.

ACCESS TO CONDUCT MAINTENANCE

This analysis and the questions it raises seem to indicate that there is a way to access the end of the Queen's Chamber shafts and that at least one additional passageway exists within the pyramid. This may lend support to Jean-Pierre Houdin's internal ramp theory, in which he proposes a ramp was constructed to enable the transport of pyramid blocks as the pyramid grew in height, and might suggest that the ramp was also used to access not only the Queen's Chamber shafts, but also other parts of the structure—whether they are working parts or not. The question that remains is where did the maintenance crew enter the pyramid to perform maintenance? Is it possible that there is a passageway behind the limestone blocks of the Great Pyramid that were shown to have a thermal anomaly on the northeast side, or did the maintenance workers take a shorter route by removing designated

casing stones high up on the south side to reveal a horizontal passageway, with the end of the Queen's Chamber South Shaft a short walk away?

Besides prompting further exploration in the Great Pyramid, it is extremely exciting to find ancient symbols and be able to clearly connect them with a previously unknown aspect of human activity in millennia past. To discover that, as I had predicted in 1998, a possible chemical supply inlet shaft does exist, although not in the place I predicted it would be, provides more proof that the foundations upon which the Queen's Chamber chemical reaction theory are built are even more solid than before. The multiple new discoveries opens a whole new area of study using knowledge and tools that have previously been excluded from ancient Egyptian studies. Fortunately, we are on the threshold of a new era, in which Egyptian engineers and scientists are recognizing that the Great Pyramid is more than a tomb. With the perspective of modern technical specialists and a renewed interest by Egypt's younger generation in solving the mystery of the pyramids, our thinking and attitudes about the capabilities of the ancient Egyptians will undoubtedly spread and their ancestors will eventually receive the credit they deserve.

SEVEN

SCIENCE OR PSEUDOSCIENCE? THAT IS THE QUESTION!

Thanks to the work of Ahmed Adly and other Egyptian researchers, such as Yousef Awyan and Mohamed Ibrahim, the Egyptians are waking up to the reality of what their monuments represent—that they are a historical record of their ancestors performing incredible feats of engineering by developing highly efficient, sophisticated tools. It has been quite common in Western literature to dismiss the abilities of indigenous peoples' ancestors and give credit for what they created to outsiders.

THE FOUNDATIONS AND STRUCTURE OF EGYPTOLOGY

Egyptians are also examining and questioning the foundations upon which the stories told about their history are based. The organized archaeological study of ancient Egypt, for the most part, was conducted by Europeans. In other words, the history books regarding ancient Egypt were written by outsiders, and the foundations for what followed were laid in the Victorian era. An awareness of how heavily Egyptology has been influence by Western scholars who absorbed the traditions and attitudes that surrounded them as they performed their studies is evident when we look at the role Egyptians have played since Europeans first began to study Egypt.

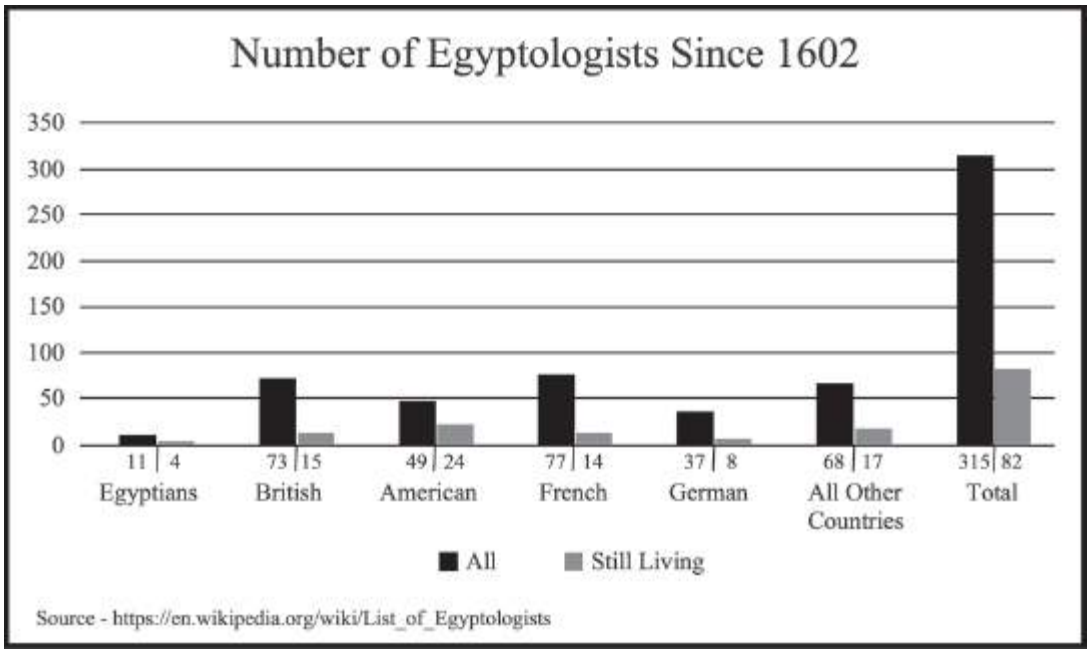

Figure 7.1. Egyptologists listed on Wikipedia.

German Jesuit scholar, Athanasius Kircher (1602–1680), is considered to be the founder of Egyptology. Wikipedia lists 315 Egyptologists from the time he performed his studies until today. During that period, 11 Egyptians are listed. Of those alive today, only 4 Egyptians are recognized, and they are overshadowed by 78 from countries outside Egypt. Figure 7.1 provides information on the countries these Egyptologists are from.

Out of the 82 living Egyptologists of different nationalities listed on Wikipedia, the four Egyptian Egyptologists are:

- Hussein Bassir, born 1973
- Zahi Hawass, born 1947
- Naguib Kanawati (Egyptian-Australian), born 1941
- Mahmoud Maher Taha, born 1942

However, there are many more Egyptian Egyptologists who apply their knowledge and training with dedication, perseverance, and care, not just in Egyptology but in other disciplines too. For instance, Aliaa Ismail, PhD, majored in both architecture and Egyptology at Cairo University and is gathering 3-D data with laser scanners within the tomb of Seti in the Valley

of the Kings. (See ScoopEmpire 2017, “Meet Aliaa Ismail, Egypt’s First Female Egyptologist.”)

There are many more graduates from Cairo University who are blessed with a vast amount of knowledge that they teach to visitors who are attracted by Egypt’s monuments and history and wish to learn more by visiting individually or as part of a tour. Those whom I have met personally, I have found to be incredibly kind and respectful. To say that all Egyptologists think the same way as those who receive most of the spotlight on the world stage would be a mistake.

The face of modern Egyptology to most of the Earth’s inhabitants today is most likely Zahi Hawass. He is probably the most famous Egyptian Egyptologist of all time. This is mainly due to his uncanny ability to make noise and attract the media, which in turn attracts millions of people around the world. His passion and dedication to Egypt is unimpeachable, and under his leadership the wealth that has flowed into the country in the tourism industry alone is incalculable.

However, of the many beliefs and narratives that influence our understanding of our ancient roots on this planet, there is one narrative that I invite the reader to examine with a degree of skepticism. The stories that started to arise in the Western world regarding Egypt’s past, told by scholars, astronomers, engineers, and philosophers from the Victorian Era to the present, need to be seriously questioned, I find. The main question focuses on those who control ancient sites—such as Egypt’s pyramids, temples, and other sites—that are increasingly being recognized as clearly displaying the application and use of advanced technology.

QUESTIONING AUTHORITY?

Atlantis Rising (Doug Kenyon, editor) published an excellent article entitled “The Big Void” in its June–September 2018 issue. Its author is world-renowned geologist and author Robert Schoch, PhD. Professor Schoch serves as a full-time faculty member at the College of General Studies at Boston University and was a recipient of its Peyton Richter Award for interdisciplinary teaching. He earned his PhD in geology and geophysics at Yale University in 1983. He also holds an MS and MPhil in geology and geophysics from Yale, as well as degrees in anthropology (BA) and geology (BS) from George Washington University. Armed with significant scientific

credentials himself, Schoch observed in his article that Egyptology, being related to archaeology, is more focused on history and art than on science, though in some cases scientists are employed to provide specialized information, such as determining the age of an artifact using carbon 14 or other dating methods or examination of terrain and structures using ground-penetrating radar or cosmic ray detection (muography). Schoch wrote:

> One of the issues seems to be that Egyptologists do not welcome the contributions of outsiders to their field. The majority of Egyptologists are (based on my experiences and observations) openly hostile toward any non-Egyptologists—especially scientists such as physicists, geophysicists, geologists, chemists, astronomers, and so on—who dare apply their expertise to Egyptological subject matter. Much of the problem may be that most Egyptologists are not scientists. Egyptology is traditionally more akin to such fields as art history, social history, linguistics, and the like. Many people have the mistaken idea that all Egyptologists are archaeologists, and archaeologists are scientists. The truth is that some (but not all) Egyptologists do carry out excavations and utilize archaeological techniques, and thus can genuinely be referred to as archaeologists, but it is debatable whether or not archaeologists should be referred to as scientists, or if it is often more a matter of archaeologists utilizing systematic techniques that on a superficial level appear "scientific" along with bringing in undoubted scientific expertise when it is useful to them (for instance, sending samples to laboratories manned by specialists—undoubted scientists—for radiocarbon dating). Here I will contend that many archaeologists, and certainly most Egyptologists, are not scientists. This is not to say that their fields of study are not scholarly, or are not legitimate academic pursuits but, rather, to delineate distinctions among various disciplines. (I have great respect for many of my university colleagues who are historians, for instance, or philosophers, or ethicists, and so on, even though they are not scientists.) (Schoch 2018)

Interest in Egypt and the mysteries that still exist there even after, or because of, the uncovering of fabulous artifacts, has continued unabated for centuries. In 1993, Schoch was invited by independent Egyptologist John Anthony West to conduct an examination and provide an analysis of the weathering of the enclosure wall and structure of the Great Sphinx, which is located to the west of the village of Nazlet El Samman in front of the Giza Plateau where the Great Pyramids are located. I have visited this village many times and have lifelong friends there. From a professional geological perspective, Schoch's analysis concluded that the Sphinx enclosure and the body of the Sphinx were subject to water erosion due to rain runoff from the Giza Plateau that must have occurred over a long period of time. Schoch is a trained scientist and was using methods and training that would need to hold up to scrutiny from his fellow geologists. Overall, with few exceptions, his peers understood and accepted his conclusions. The reader can access his books and published articles on his website, The Official Website of Robert M. Schoch.

Schoch's analysis revealed that the currently accepted dates for the construction of the Great Sphinx could not be correct because of a lack of rainfall during the time period suggested by Egyptologists for its construction. He was met with a firestorm of opposition from Egyptologists, the most vocal of whom was Zahi Hawass, who at the time was director of the Giza Plateau. A casual observer would assume that two professionals with PhD after their names would surely have equal status and therefore be on equal footing in a debate. Schoch, however, calls into doubt the balance of authority in this particular instance by stating that, unlike himself, Egyptologists cannot be considered scientists. The obvious question arising from that conclusion is who do we believe: the scientist (Schoch) or the Egyptologist (the latter being considered by Schoch to be a nonscientist)?

Exploring this further, we know that the title of doctor is applied to some professions that, while performing immensely valuable work and benefitting society, cannot be considered to be hard sciences. Take, for instance, the doctor of divinity degree that is bestowed on theologians. A vastly knowledgeable person holding this degree may be faithful to the scientific method in their vocational or avocational pursuits, but by its nature their doctorate cannot be considered to be a branch of the hard sciences.

DESCARTES'S PHILOSOPHY

Other than taking Schoch's word for this opinion, does other evidence exist to support his claim? Certainly, the main public figures of Egyptology hold passionate beliefs, to the level of religious fervor, that they are providing the public with truths about Egypt's past. But could it be that they are acting more from an ideological perspective than from the results of hard, scientifically acceptable methods employed in their work? The beauty of René Descartes's philosophy and his famous meditation on doubt, "That which can be doubted must be rejected," is that passionate beliefs do not hold up if they cannot be supported by the objective application of the scientific method—which guides hard sciences in their pursuit of truth and should really guide everyone.

> But inasmuch as reason already persuades me that I ought no less carefully to withhold my assent from matters which are not entirely certain and indubitable than from those which appear to me manifestly to be false, if I am able to find in each one some reason to doubt, this will suffice to justify my rejecting the whole. And for that end it will not be requisite that I should examine each in particular, which would be an endless undertaking; for owing to the fact that the destruction of the foundations of necessity brings with it the downfall of the rest of the edifice, I shall only in the first place attack those principles upon which all my former opinions rested (Descartes 2008).

Following Descartes's philosophy, therefore, if a single piece in a structure, or mode of thinking, can be doubted or cannot be proven, the whole structure must come down and be reconstructed with pieces that are unimpeachable. You could argue that this rarely happens, and you may be correct, but in the hard sciences it has become accepted wisdom and essential. Not so by at least one Egyptologist, however, who angrily and unprofessionally attacked Schoch when he offered a geologist's analysis on the weathering within the Sphinx enclosure.

> The initial hoopla peaked in February 1992 at a "debate" on the age of the Great Sphinx held at the Chicago meeting of the American Association for the Advancement of Science. As the New York Times put it, "*The exchange was to last an hour, but it spilled over to a news conference and then a hallway confrontation in which voices were raised and words skated on the icy edge of scientific politeness*." Egyptologist Mark Lehner could not accept the notion of an older Sphinx, personally attacking me by labeling my research "pseudoscience" (Schoch 1992 and 2010).

While the old proverb "People in glass houses should not throw stones" is frequently ignored, it is useful to remember when criticizing another person for whatever reason. Considering how Robert Schoch has been mistreated by Egyptologists in the past, particularly by American Egyptologist Mark Lehner, who accused him of practicing pseudoscience, or Zahi Hawass calling new ideas that challenged the established beliefs of Egyptologists the products of "hallucinations," it is understandable that Schoch would write a negative review of Egyptologists' scientific standards, but are his criticisms merely sour grapes for the way he has been treated or is there justification for them, with evidence to support him?

It would seem that even a layperson with a rudimentary understanding of how science works and its associated rules of evidence would agree that a more powerful argument supporting Schoch's contention that Egyptologists are not qualified to be considered scientists is made by Egyptologists themselves. What better source of testimony exists than the words from three world-renowned Egyptologists' own mouths in September 2002 as they were peppered with awkward questions from the inquisitive host and narrator of a documentary chronicling the exploration of the Queen's Chamber South Shaft and much-heralded penetration of Gantenbrink's door?

Struggling to provide satisfactory answers to the narrator's questions, the objectivity and scientific thought process of leading Egyptologists from Egypt (Zahi Hawass), the United States (Mark Lehner), and Germany (Rainer Stadelmann, 1933–2019) were on full display and broadcast to the world on September 16, 2002, from the Giza Plateau and, particularly, inside and outside the Great Pyramid. The video of this broadcast can be

seen on YouTube in “Into the Great Pyramid” (National Geographic 2002). I will insert the timecode in my text below in brackets.

The 2002 live broadcast reached an audience of 30 million in the US and many millions more around the world. Of these, there were probably a few million that recorded the program on their VHS recorders. One of those millions was me. While I recorded it for future viewing, I probably only watched the last 10 minutes over again before the video went into storage and eventually became obsolete. Considering the evolution of modern technology over the last 20 years, when this video became relevant to my research again, I didn’t go digging around in a plastic storage container, even though I still have my old VHS player (also in storage and not hooked up). I turned on my computer and searched for it on YouTube. What a difference in viewing experiences! The benefits of searching for a relevant scene and also being able to read the live transcripts is a dream compared to what was available in 2002.

As the National Geographic hosts, Laura Greene and Jay Schadler, built up the anticipation and excitement with the help of Zahi Hawass and Mark Lehner, Greene held a revealing interview with Hawass in the Queen’s Chamber:

GREENE: One question I have to ask you, Zahi—people back home are gonna wonder—has anybody had a peek? [12:48]

HAWASS: No. But I have some ideas, we will talk about it tonight. But I don’t think that anyone could find out exactly what is behind this door. [12:52]

Greene then passes off to Schadler at the overseer’s tomb in a segment that lasts for around eight minutes before the filming returns to Greene and Hawass in the Queen’s Chamber discussing what was appearing on the computer screen as the Pyramid Rover ascended the shaft. As if a beat wasn’t missed since her previous question of Hawass, Laura Greene persisted:

GREENE: No, Zahi, as we have said, you are the expert. The question on everybody’s mind has got to be, what do you think is behind the stone door? [26:20]

HAWASS: Laura, listen. We are sure now that this door is about three and a half inches thick. Therefore, it's a door with two copper handles for the rope to pull that door. Something should be behind it. [26:29]

GREENE: What though? What do you think it might be? [26:42]

HAWASS: I will tell you, if we will be optimistic and think the treasures of Khufu could be hidden here, and even if we are not optimistic and see a small corridor, or a hollow or something behind it, I believe it's a great discovery, because something inside the Great Pyramid to be seen for the first time; it's important for everyone to see that. [26:45]

Following preliminary discussions on the iRobot's function, its demonstrated ability to drill a hole through limestone, and some of its struggles ascending the shaft, Hawass and remote sensing expert Meg Watters climbed up the south face of the pyramid and paused at a spot about halfway up where the Queen's Chamber South Shaft should have emerged had it continued at the same angle to the outside. Their conversation went as follows: [1:20:25]

HAWASS: We are near that shaft now.

WATTERS: OK.

HAWASS: But the archaeologists here at Giza looked everywhere on the surface, OK, on the south here and could not find any evidence at all of this shaft anywhere that has a hole outside.

WATTERS: Can you tell me what the shafts were for? [1:20:43]

HAWASS: It is my theory, my belief, that the south shaft functioned as a symbolic corridor for the soul of the King, as the Sun God Ra, to go through that shaft—that in the mind of the Egyptians, the soul of the King will go through that shaft. The northern one is also a model corridor for the King's soul, as the God Horus, to go in the north hemisphere. [1:21:08]

NARRATOR: The role of the shafts must have been very important, because building them was incredibly difficult. They weren't just drilled through the pyramid. As we have seen, they were carefully laid out as the pyramid went up layer by layer. So why would the King's soul need these special shafts to exit the pyramid instead of just simply going down the Grand Gallery and using the regular exit? Egyptologist Rainer Stadelmann thinks that the King refused to. [1:21:41]

During the voiceover narration at the time the question is raised, respected German Egyptologist Rainer Stadelmann, the director of the German Archaeological Institute in Cairo from 1989 to 1998, is seen climbing up the Ascending Passage and standing beside the North Shaft inside the King's Chamber. He responded to the question:

STADELMANN: This was very important because, as written in the Pyramid Texts, the King said that 'It is my distaste to descend into the Earth. I, the King, ascend directly to the sky.' [1:21:59]

Understandably slightly perplexed by Stadelmann's answer, another awkward question was posed.

NARRATOR: But if the King's spirit went from his burial chamber to the sky, then why go to the trouble of building shafts for the Queen's Chamber, where the King was never buried? The answer may be linked to magic. Mark Lehner thinks the Queen's Chamber was a dummy chamber, inhabited by the King's soul that would need to move out of the pyramid to the heavens. Then wouldn't a stone door pose a problem? [1:22:27]

These were all excellent questions that would be on the minds of any objective viewer, but then the narrator introduced the idea that magic was involved, which led to American Egyptologist Mark Lehner providing an answer.

LEHNER: A blocked passage would be no problem for the King's soul. It didn't have to be open for the King to ascend. The principle means for going into the otherworld in any normal Egyptian tomb was what we call a false door. A dummy door. But when they made a simulated door

out of stone, then it's magical and then it can commune with another world.

This raises the question, if the King's soul can pass through stone without any problem, why does he need a shaft? Does he need directions on which way to go, and the directions are written on sacred scrolls behind Gantenbrink's door? It's all very confusing. Four shafts from two locations pointing in different directions that are necessary additions for the King's soul to exit his tomb. Four shafts, the construction of which would require enormous amounts of time and resources to include in the design scheme. Absent any objective evidence to support the notion, this portrays the scientific mindset of at least three world-renowned Egyptologists. But there is more:

NARRATOR: But if the blocking stone is kind of a magical false door, why does it appear to have handles? [1:22:55]

Again, another excellent question, the answer to which is provided by Egyptologist Rainer Stadelmann, who is still stationed in the King's Chamber by the North Shaft:

STADELMANN: These copper fittings are magical instruments which the King can take, the soul of the King can take, when it ascends. It uses them to open this block and pass through the stone to the sky. [1:23:11]

There is a slight difference between Lehner's and Stadelmann's explanations. Lehner claimed that the soul of the King would have no problem passing through this blocking stone, while Stadelmann stated that magical handles are necessary for the soul of the King to raise the block before passing through the stone to the sky, even though the shaft does not continue on to the sky. The narrator continues her ruminations in voiceover:

NARRATOR: Magic was essential to Egyptian rituals, and Khufu's burial chamber must have contained all sort of papyrus scrolls with magical writings. Prayers to help him on his way to the heavens. But what about behind the stone?

STADELMANN: It might be possible that there is, let's say, a papyrus roll behind these stones. There's no place for much more.

Stadelmann's comment is very revealing. "There's no place for much more." How does he know that? At this stage in the exploration, according to Hawass, nobody has taken a peek, even though he said that when a peek is finally taken, there may only be a small space behind it. Hawass and Stadelmann have essentially told the audience not to expect much of a discovery when the robot reveals to them for the first time what is behind the so-called door, while Hawass, for one, is claiming that nobody has taken a peek. It should be noted, moreover, that there is ample room behind Gantenbrink's door for a huge space, using the dimensions between the end of the shaft and the outside and also if the builders wanted to take up a large amount of room to the east and west. Surely, a room the size of the so-called King's Chamber would fit—which is what they were hoping to find and which was the impetus for this exploration.

When the camera was inserted into the hole that had been drilled through the "door," great excitement and bated breath permeated the Queen's Chamber. Finally, the camera revealed a small space, as suggested by Stadelmann and Hawass, and to much fanfare, Hawass announced that across the space was another "door" with a crack! A very important discovery and important for the whole world to learn about as it was revealed for the first time!

HAWASS: We are here in front of a discovery. This is incredible and I am really happy that we got this. We found the space. We found another sealed chamber. [1:24:13]

NARRATOR: This is incredible. This is the first time a space has been advanced within the Great Pyramid within 130 years.

HAWASS: I know, but Laura, this is very important. This is something I'm very proud that finally we revealed the first mystery of the Great Pyramid of Khufu. [1:25:41]

During this documentary, Egyptologists essentially confirmed Schoch's assertions that Egyptologists are not real scientists. But did they also shade

the truth about not knowing what was behind Gantenbrink's door before it was broadcast live to millions of viewers around the world? Was what we witnessed on September 16, 2002, an honest account of the application of science in pursuit of truth, or were Egyptologists following a script given to them by filmmakers who just wanted to tell a good story—a story presented in the same tradition as other stories told through the lenses of filmmakers, whose main objective throughout history has been to attract the largest audience possible for their creations? In this case they succeeded, for by all accounts tens if not hundreds of millions of people tuned in.

Perhaps the words of a respected Egyptologist who was not involved in this production stated it best. Iorwerth Eiddon Stephen Edwards, CBE, FBA (21 July 1909–24 September 1996) was the Assistant Keeper in the Department of Egyptian and Assyrian Antiquities from 1934–1955, and Keeper of Egyptian Antiquities from 1955–1974. In his illustrious forty-year career, he was considered to be the leading expert on pyramids, and his book *The Pyramids of Egypt*, published by Penguin in 1947, is considered to be a classic scholastic work that has been through many revisions over the years. In an interview for a documentary for Netherlands Television and reissued by History's Mysteries under the title "Secrets of the Pyramids and the Sphinx" (History's Mysteries 1995), Edwards gave his thoughts about the importance of pyramids.

> Edwards: Pyramids, in general, are not very popular with Egyptologists because I think they are too plentiful. There are about a hundred of them. And also, I think they have acquired something of a bad name because they have attracted so many cranks. (As of 11/28/2015, "Secrets of the Pyramids and the Sphinx," Maximum Truthseeker, YouTube, timestamp 4:30.)

For those who are not familiar with the term "crank," as used by Edwards in this case, a list of synonyms are: character, codger, crack, crackbrain, crackpot, eccentric, flake, fruitcake, head case, kook, nut, nutcase, nutter [British slang], oddball, oddity, original, quiz, screwball, weirdo, zany. Hmmm . . . I think I see "fruitcake" in there.

It is understandable that a researcher, using the best scientific methods, may interpret the symbols and writings of an ancient culture and come to an

understanding that the ancient culture was deeply vested in a belief in magic. This culture's belief may have ruled their lives and formed a basis for most decisions that they made. The question is, do real scientists include magic when explaining their observations?

Not being immersed in these teachings and beliefs, an outsider may question an Egyptologist's reliance on magic to explain physical features crafted into the Great Pyramid. In fact, one might argue that the Egyptologists involved in the 2002 exploration of the Queen's Chamber South Shaft in the Great Pyramid, while they may be well-meaning and sincere in their beliefs, have revealed by their performance a breathtaking vacuum where objectivity, science, and common sense should exist. Invoking magic to explain physical features found within the shaft reveals a mind filled more with fantasy and religion than a scientific mind. Fantasy and religion may have their place in the minds of believers. However, it should be recognized for what it is and be absent from scientific analysis.

Nevertheless, so powerful is the grip of magic on Egyptology that any attempt to introduce a new idea or different way of looking at something is met with resistance and, in a lot of cases, hostility, such as when Lehner accused Schoch of practicing pseudoscience.

Inspired by the observations of R. A. Schwaller de Lubicz that the erosion of the Sphinx and its enclosure was the result of water flowing down from the Giza Plateau over 10,000 years ago, John Anthony West had encouraged Robert Schoch to get involved, for, if the science supporting the theory for an earlier date for the Sphinx construction was to be debated, it was required that the debaters hold a PhD. West, who did not hold a PhD, was not qualified to advance his de Lubicz-inspired theory in the debate, which was organized by the American Association for the Advancement of Science. In the same video in which Edwards made his comments, journalist Paul William Roberts, who covered the 1992 debate, made the following compelling observation:

> West is really an academic's worst nightmare. Because here comes somebody from far out in left field with a thoroughly well-thought-out, well-presented, coherently described, beautifully written [theory] full of data you can't refute, and it pulls the rug from beneath your feet. So how do they deal with it? They ignore it. They hope it will go away. But it won't go away. [32:13]

Ancient writings as well as recent writings are not the best evidence. Without firsthand testimony as to the origins of and meaning behind the writings, what exists may be considered hearsay. Most of what we have learned about ancient Egypt and the Great Pyramid is based on writings from the past. With respect to what its origins are, what its purpose was, and how it was constructed, what is painted or inscribed on an ancient wall may have the same historical value as graffiti that is spray-painted on the side of a train or the bridge it passes over.

In *The Demon-Haunted World: Science as a Candle in the Dark*, Carl Sagan said, "*The cure for a fallacious argument is a better argument, not the suppression of ideas.*" Who could reasonably argue with this point of view? Ideas that are supported by fallacious arguments have always been a factor for some when shaping a message to convince people to buy what is being sold. Politicians are well known for it. If the first thing a person did before writing anything online was to learn what logical fallacies mean and how they are used, they will be doing themselves and the world a favor.

Totschweigetaktik, an Austro-German word, means "death by silence." Invariably, when a different idea that is free of logical fallacies is proposed, for many reasons it will be resisted by silence. In "The Big Void," Robert Schoch identified a condition that is common not just in the culture of Egyptology but also in other fields of endeavor around the world. It is known as NIH or the idea that something was "Not Invented Here" and is therefore ignored.

> It is not always clear to me why the Egyptian authorities, and certain non-Egyptians working with them, continually want to downplay, politicize, and even dismiss or totally deny the discoveries of well-trained scientists and experts. There seems to be a pattern that if something is not "discovered" by the card-carrying Egyptian Egyptologists or their close associates, then it must not be real—or if the reality of the discovery cannot be denied, then it must not be significant and/or it was known all along. (Schoch 2018)

The only objective scientists in the Queen's Chamber during the course of this explorations, it seems, were the Pyramid Rover builders and operators. They were using a product designed and built out of components

that were underpinned by hard science. There was no ambiguity or any reason to question their confidence that their robot would work, and if it didn't, they would employ science and engineering to fix it.

Hidden secrets, mysteries and answers to questions that have persisted for millennia have an appeal that is hard to ignore. But even after the plethora of books Egyptologists have published on the subject of pyramids, there remains to be explored mysteries and secrets that attract millions of visitors a year. Some internet conspiracy theorists have argued that Egyptologists have discovered some remnants from a lost civilization that they are not sharing with the world. I would not argue support for that point of view, but I do recognize that keeping valuable information secret is not new. It flourished in full force in Italy when tile layers would hold the tricks of their trade within a closed group or guild. Italian tile layers were the finest in the world and they wanted to keep it that way. During that period in our history, who could blame them? The question is, will this practice survive the scrutiny of future generations?

Edward Leedskalnin was a Latvian immigrant who built Coral Castle in Florida and performed amazing feats that have drawn millions from around the world to marvel at them. Unfortunately, Leedskalnin was afflicted with the Italian tile layer syndrome, and the secrets that would allow others to replicate his feats are still a mystery that he took to his grave (Dunn 1998, 109).

Nevertheless, even without help from holders of secret knowledge, physics, science, and engineering continue to evolve and share their knowledge with the world to improve living conditions and enhance awareness through their inventions. I wonder if we would be further along if they had revealed the secrets they hold? I doubt it. With the exception of Edward Leedskalnin, I suspect the answer is a resounding no.

In a remarkably well-crafted monologue at the close of the documentary about the opening of the "door," Jay Schadler provides a philosophical, though necessary, caveat for what we had just been treated to:

> Wah, what a night, ah? Already the work of recording and analyzing what was found here has begun at the site, and we should tell you that from, really from the moment this project was conceived, everyone here at National Geographic has understood that we were involved in a kind of twenty-first-century experiment. A blending of

> hard science and television. They can make strange bedfellows, and no one knows that better than us. After all, science demands patience—television craves experience. Still, both are seeking a kind of revelation to reveal what is hidden beneath the surface of things and to be honest, I suspect that no one's heart beats faster at the moment of discovery than the scientist's. If we have managed tonight to give all of you at home a glimpse into that world, into that moment when the unknown becomes known, then we'll consider it a success. Tonight, we still stand on sacred ground. Home to the world's first great civilization. Now, for Laura and Dr. Hawass and everyone here at National Geographic, I'm Jay Schadler. Goodnight from the Giza Plateau and the Great Pyramids.

The mystery and the magic spells that have been fondly enriched and amplified before being served to a ravenous population that covers the globe has its roots in old Hollywood movies. Even the drama surrounding Lord Carnarvon's death after a shaving cut became infected included speculation that it was a mummy's curse that sent him to his grave. Were ancient evil forces really at work when *Death on the Nile* was being filmed?

Egypt, with its pyramids and temples, has long been the greatest show on Earth, and hushed utterances about magical mysteries and "secrets to be revealed" reside in the scripts of many promoters who wish to attract seekers of wisdom and enlightenment. The magic and the mystery is an alluring potion that captivates and enchants. But if we focus on just the science, even more wonders can be revealed.

> Science arouses a soaring sense of wonder. But so does pseudoscience. Sparse and poor popularizations of science abandon ecological niches that pseudoscience promptly fills. If it were widely understood that claims to knowledge require adequate evidence before they can be accepted, there would be no room for pseudoscience. But a kind of Gresham's Law prevails in popular culture by which bad science drives out good. (Sagan 1996, 6)

Gresham's law, referred to by Sagan, originated in the finance industry, where it is said that bad (overvalued) money drives out good (correctly

valued) money by appealing to less discriminating investors.

With what we have witnessed from world-renowned Egyptologists, does Sagan's metaphoric use of Gresham's law, where bad science drives out good science, apply to their work product? Considering the lack of scientific evidence put forward to support conclusions explaining important features in the Great Pyramid, there is a strong argument in support of Schoch's opinion, which argues that Egyptologists are not scientists, despite the number of skeptics that may align against him. I have found that most ardent self-proclaimed skeptics seem only to be interested in focusing their skepticism on new ideas. That's a shame. They end up defending the status quo while attacking true skeptics, like Schoch, who have legitimate questions and innovative ideas about what has previously been accepted as truth.

Referring again to Arthur C. Clarke's quote that "*Any sufficiently advanced technology is indistinguishable from magic*" and considering at least three eminent Egyptologists' inclinations to invoke magic when trying to explain features of the Great Pyramid, would it be outrageous to suggest that perhaps they had become entangled in Clarke's maxim? Were they interpreting what they were studying as magic while in truth they were faced with "sufficiently advanced technology" but were unable to recognize it for what it is?

However, many today do recognize that the Great Pyramid was constructed using advanced technology for the purpose of creating energy in a unique and technologically advanced way. The truth, however, can only be found through the application of good, scientific, Cartesian principles. It is a candle in the dark where magic will find no comfort.

EIGHT

SAQQARA'S HIDDEN TREASURES OF ADVANCED TECHNOLOGY

A popular tourist attraction when traveling to Egypt is Djoser's pyramid at Saqqara—commonly known as the Step Pyramid. When I visited there in 1986, I was completely unaware of another site called the Serapeum just over a half mile away. There is not much to see from a distance, but when you get closer you will see steps leading down an incline to heavy iron doors set in the bedrock. Behind those doors are probably the most mysterious and confounding discoveries ever made on this Earth. An account of my research prior to 2010 is published in *Lost Technologies of Ancient Egypt*. In this chapter, I will broaden the scope of my previous studies, which leads to the question, "Why was the Serapeum created?" A possible answer to this question will shock you.

WHERE ARE THE MACHINES?

Since I ended *Lost Technologies of Ancient Egypt* with the question, "Where are the machines?" it seems appropriate to ask the same question in this book. Its relevance persists in many minds that consider the conclusion both Petrie and I reached—that the ancient Egyptians used sophisticated machines to shape stone. The Serapeum's monolithic boxes reinforce this point of view.

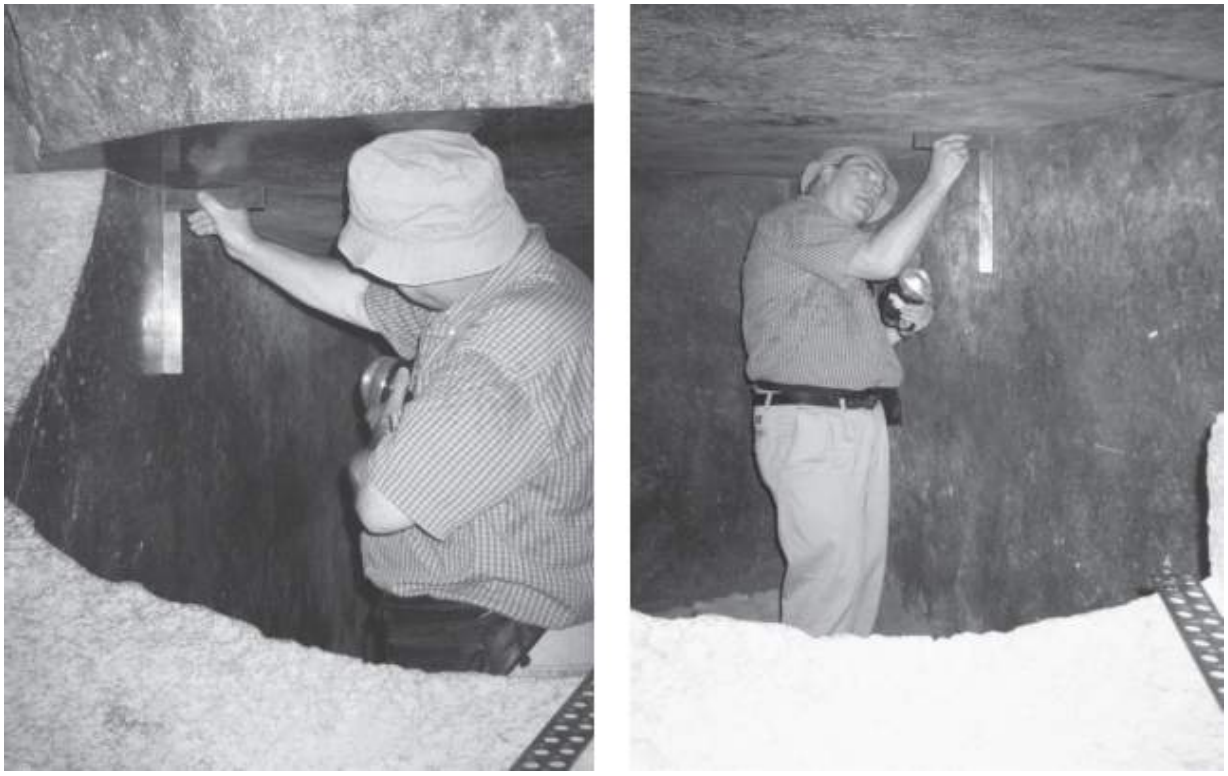

Figure 8.1. Christopher Dunn inspecting the remarkable precision of a granite box in the bedrock tunnels of the Serapeum.

Figure 8.2. Steps leading to the Serapeum at Saqqara.

Figure 8.3. Entrance to the Serapeum at Saqqara.

When passing through the iron door, you enter a cavernous room. Figure 8.4 shows a large granite block that is roughly finished but ultimately destined to be crafted to serve as a lid. Its weight is estimated to be around 28 tons. To the right of the entrance is a tunnel, which, partway down its length, contains a box that has been roughly quarried and roughly finished on the inside (see Figure 8.5). Passing by the lid in the entrance hall, to the right is another long tunnel in which large openings with vaulted ceilings are cut into the walls and staggered along the length of the tunnel. These openings are cut above and below the level of the tunnel floor and are commonly referred to as crypts. Inside the crypts have been placed massive granite boxes that measure approximately 13 feet long × 7.5 feet wide × 8 feet high (3.96 × 2.28 × 2.44 m). Each crafted from a single block of granite, with the insides cut to shape, but without their lids, the boxes have been estimated to weigh 70 tons and the lids 25 tons. (A complete survey of the entire facility needs to be performed in order for more

accurate estimates of each individual box.) Significantly, the boxes are centered in the crypts and installed in a recess in the floor. Other tunnels exist in this complex and all told there are 24 such boxes in these underground bedrock tunnels.

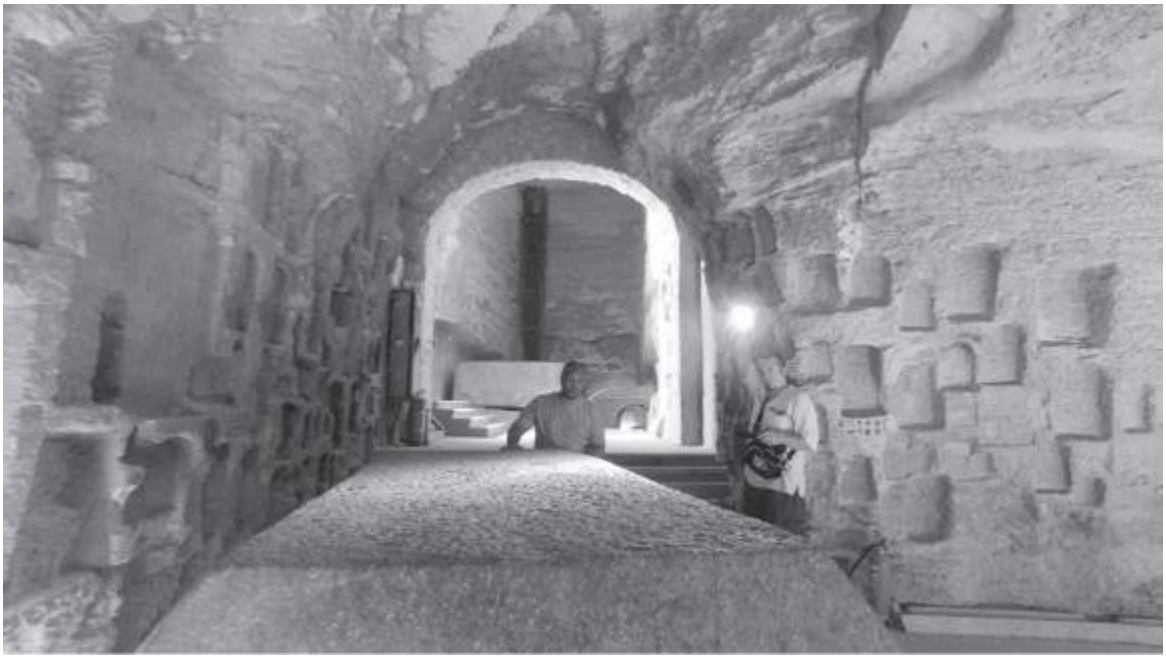

Figure 8.4. Ben Van Kerkwyk and Yousef Awyan in the Serapeum entrance hall by the granite lid.

Figure 8.5. Rough-finish box in Serapeum tunnel. Image credits: Ben Van Kerkwyk.

There is a drop of several feet from the tunnel passage floor to the crypt floor. Why this was necessary has long been a mystery. Installing the boxes would certainly have been less complicated and difficult if the crypt floor was on the same level as the tunnel floor, so why the creators of these enigmatic, subterranean vaults made it harder for themselves by going to all the extra work poses a question that I will try to answer. Their effort is to be admired, but what were they trying to achieve?

Engineers are well-known for stretching their ingenuity when faced with an engineering mystery. I'm fortunate in the past to have been in the company of some exceptional engineers while they have been grappling with this question. One idea, which I will address later in the chapter, rang true to me, as it opened a path to providing possible answers to most of the major questions raised, such as:

- Why was extreme precision needed on the inside of the box?
- Why was this precision *not* a requirement near the bottom of the box?
- Why did the lids to the box also need to be precise?
- Why were the crypt floors lower than the tunnel floor?
- Why were the boxes placed in a recess in the floor of the crypt?

As Ahmed Adly discovered, the inside of the box he measured was precise, with the walls of the interior flat and parallel with each other and the corners all being 90 degrees square. His measurements provided support for the observations I made in 1995, 2001, and 2013, with the exception that he used a laser measure and digital protractor, whereas I used a toolmaker's precision straightedge and solid square. The straightedge, precise to within two ten thousand parts of an inch (0.0002 inch [0.00508 mm]), provided an additional attribute: the flatness of its surfaces. At the location where I used the 12-inch straightedge, no light was seen passing through the interface where the steel straightedge was placed on the granite surface—regardless of how the straightedge was turned, whether vertically, horizontally, or at an angle.

From a manufacturer's perspective, these discoveries essentially *prove* the existence of a technologically advanced civilization in Egypt's remote past.

With young engineers now performing their own inspections of the boxes in the Serapeum, “Where are the machines?” is usually the first question asked by those who do not believe the ancient Egyptians were that technologically advanced because of what has been found in the archaeological record. What are the implications to accepting that they *were* that advanced and what we have been taught in school is *wrong*? The history of the human race would need to be reassessed and history books that place Egypt behind Greeks and Romans in terms of technical accomplishment would have to be rewritten. Is it surprising that there is resistance to such an idea?

The question “Where are the machines?” also presents a bit of a conundrum. On the one hand, we cannot assume that machines used in ancient Egypt would be similar to and work in the same way as modern machines. Supporting that point of view is an advanced machine from ancient Egypt that has the shape of a pyramid, and when you consider how it is designed and built and how it may have operated, there are no modern machines to compare it with. On the other hand, the pyramid electron harvester concept, as presented in my first book, *The Giza Power Plant,* is questioned because it does not resemble any machines that we are familiar with, and there are no known electrical devices or appliances in the archaeological record that it may have powered. The mindset that the ancient Egyptians were not capable of creating precise complex machines seems to be one of the reasons for not accepting that machines were used to craft many of the impressive artifacts found in Egypt. But yes, they were, and they did!

In the context of the Serapeum boxes, I am fully aware that if I am asked “Where are the machines?” pointing to the pyramid machine is not quite the answer the questioner was seeking. Nevertheless, the pyramid machine does provide evidence that the ancient Egyptians were familiar with machine-like precision and sophisticated function, even if the pyramid machine is not designed to finish-grind the inside of a granite box.

While my peers who are familiar with manufacturing processes and what tools and methods are capable of achieving might look at the magnificent boxes in the Serapeum and conclude that precision machines *had* to have been used to make them, a layperson without a similar background probably feels justified in asking, “But where are the machines you speak of that did this work?”

In *Lost Technologies of Ancient Egypt*, the foreword by mechanical engineer Arlan Andrews Sr. presented a cogent argument that the question of lost technologies is not confined to the technologies developed by prehistoric civilizations, but that technologies used even in our lifetime are vulnerable to obsolescence when those who developed them and knew how to use them eventually pass away. What they created does not necessarily continue to exist in its originally manufactured form but is disassembled and the materials repurposed for use in modern products. It could be that the car you drive today, or even the bridge you drive it across, contains materials that were once used to manufacture an earlier model automobile.

I recently discussed with Andrews the difficulty some people have accepting that machines *must* have been used to create many of the artifacts in Egypt, and he kindly provided me with a quotation to be included in this book:

> To those critics who demand that the proposed ancient machine tools be discovered before paying any attention to the incredible manufacturing technologies displayed by the dozens of "crypts" at Saqqara, let us imagine finding a similar structure in the future, only in the deserts of Mars, not Egypt. What would the reaction be? What would be the most important questions?
>
> If those early interplanetary explorers were to come across a cliff opening that was the entrance to a long, carved tunnel which opened to a series of enclosures housing incredibly huge black stone boxes weighing many tons, precisely machined on the insides and situated in recessed niches, yet having no workers' tools left behind, do you think that their first reaction would be "Where are the machines?"
>
> Obviously not! The scientists and engineers would report the impressive artifacts assuming that the application of machines was a given: "They are there. They are massive. They are obviously manufactured. They are precisely machined, because no conceivable human (or Martian) hand (or tentacle) could possibly accomplish the flatness, the parallelism, or the plethora of other features we have documented, unless they possessed sophisticated guidance mechanisms, for cutting tools along with associated metrology instruments.

> Our Martian research team's relevant questions then are, "What advanced civilization made these monumental artifacts? How did they do it? When was it done? What was the purpose? And, most importantly, where do we go from here with our research?"
>
> To my mind, present-day researchers of Egyptian artifacts like those at Saqqara should focus on the available evidence—the boxes. They are massive. They are obviously precisely machined because no conceivable human hand could possibly achieve their geometry and exactness without the assistance of precisely powered machinery.
>
> So, the relevant questions today are the same questions our hypothetical future Mars explorers would have: "What advanced civilization made these monumental artifacts? How did they do it? When was it done? What was the purpose?"
>
> And the most relevant question for today's researchers is: "Where do we go from here?"
>
> (Email received from Andrews on January 21, 2022)

Andrews described an alternative path that discoverers may follow, depending on their training and background and the background and training of those who join them in analyzing the discovery. In the fictional account above, perhaps because of a planet-killing asteroid impact or coronal mass ejection (CME) event, the entire civilization on Mars was completely wiped out. The planet became uninhabitable and there were no survivors.

A well-used aphorism claims, "Those who forget history are doomed to repeat it." I would like to challenge that caution by asking, "Whose version of history are we supposed to believe and not forget?" Historical interpretations of ancient artifacts, such as the boxes in the Serapeum, do not include a detailed engineering analysis using modern instruments. The activities that are recorded and reported as historical events come from many sources, including prime witnesses who were on the scene when a discovery was made; scholars who examine ancient artifacts; books that provide interpretations and stories about their meaning; other observers, philosophers, and reporters; and, ultimately, the general public.

The first visitors to the hypothetical Mars tunnels most likely will have a background in the sciences, being perhaps a geophysicist, geologist, or

even an engineer. Along with others with a technical background, it's the kind of group you would expect to be selected to crew a space mission to another planet. I think we can agree that Egyptologists did not have a hand in creating the Serapeum, and they would probably not be selected to crew a space mission to Mars.

The first explorers who discovered the Serapeum made their discoveries before the Industrial Revolution began or picked up full steam. The discovery was made before Egyptology was established as an academic study, but after it was, their analysis of the site was not informed with the knowledge and education that a spacefaring civilization would need. That is not a criticism but a reality. Nonetheless, recent interdisciplinary research teams possessing a broad range of knowledge have begun researching the site and finding that a different story needs to be told.

The difference between Earth and Mars in the two scenarios is the extent of devastation on the planet where they are located. In Andrews's fictional scenario, we can imagine that the planet Mars suffered a mass extinction event and there were no survivors. On Earth, one of the effects of a mass extinction gave rise to what is known as the "bottleneck theory." This is when the diversity in human DNA is reduced significantly when a large part of earth's population is wiped out. One event, that reduced the world's population to just a few thousand, is believed to be when the super volcano, Toba, erupted around 75,000 years ago: "In 1998, the bottleneck theory was further developed by anthropologist Stanley H. Ambrose of the University of Illinois Urbana-Champaign. However, some physical evidence disputes the links with the millennium-long cold event and genetic bottleneck, and some consider the theory disproven" (Wikipedia, Toba Catastrophe Theory).

While the Toba eruption is one cause of mass extinction, others such as asteroid, meteorites, and coronal mass ejections have been identified as causes of others. It doesn't take much of a stretch of our imagination to consider what might have existed before such events occurred. How technologically developed were the inhabitants? How much of their infrastructure would survive such a conflagration? What has survived for thousands of years that have caused a lot of us to scratch our heads are the pyramids and the many other examples of monolithic stonework being worked to a high order of precision. I believe that one such extinction event brought an advanced civilization to a screeching halt, leaving few survivors

who had the resources to understand and continue that society's advances in technology and who did not possess the ability to rebuild.

Perhaps, like us today, those who created the boxes in the Serapeum were served by a scientific and technical infrastructure that was a delicate web of knowledge and materials skillfully orchestrated to provide them with comfort and convenience. Today, a significant event could wipe out one or more critical components necessary for our lifestyle to continue. Our comforts and convenience would be like a house of cards that could collapse entirely if we suffered such an event in the future.

In our era, the study of ancient artifacts falls under the purview of archaeology. In Egypt, it is controlled by the Ministry of Antiquities. It is often said that the winners get to write history. In the case of the Serapeum, the winners were and are those who planted their flag first. The Egyptologists on Earth got to write their opinions about the monolithic boxes in the tunnels at the Serapeum first. In the alternate fictional scenario on Mars, the scientists and engineers got there first and the story they would tell was completely different and more than likely the one that would endure. However, engineers are now entering the tunnels of the Serapeum with a different set of tools than those used by Egyptologists. Instead of taking with them a brush and trowel, they are employing precision instruments such as straightedges, squares, protractors, and laser measuring instruments to gain a deeper understanding of the truth inside the boxes' empty spaces.

A few years after *The Giza Power Plant* was published, it became clear to me that it was not making—and would not make—a dent in the way mainstream Egyptologists think of ancient Egyptian history. I had fallen victim to *totschweigetaktik* (death by silence), and came to realize that if my observations were going to be accepted and make a difference in the status quo, the people who had the most to gain would be the Egyptians. If Egyptian history was going to be rewritten, then the Egyptians should decide if it should be rewritten, and the Egyptians should be the ones who rewrite it.

I also concluded that if I wanted to penetrate the cracks in the structure erected by Egyptologists*, The Giza Power Plant* was, metaphorically, the thick end of the wedge. In 2010, I published *Lost Technologies of Ancient Egypt*, which was designed to be the thin end of the wedge. The people most suitable for hammering that wedge into the cracks would be Egyptian

engineers. To that end, I dedicated the book to "The Egyptians and their glorious heritage." Also, within the book I appealed to Egyptian engineers to examine for themselves artifacts I identified as products of a highly advanced civilization that possessed superior manufacturing abilities—their ancestors. In *Lost Technologies of Ancient Egypt,* I wrote:

> "The complexity of a box is not quite that of a statue or even the cornice block near the Valley Temple at Giza. Yet the message from the tunnels of the Serapeum is one of metrology and exactness. While at the moment precision is inferred from the geometry and symmetry of the statues, the boxes in the Serapeum let us know quite clearly that the ancient Egyptians were no strangers to such exactness. *The lapidary work on the insides of these boxes should invite further studies by Egyptian engineers* who can interpret the information that is crafted into the meticulousness with which these giant, enigmatic artifacts were made."

That strategy seemed to be the right approach. Egyptian engineers are now interested in examining with modern tools the monuments built by their ancestors, tools Egyptologists may not be aware of. As it turns out, accompanying them now are Egyptian tour guides who interact with tour groups interested in *Lost Technologies of Ancient Egypt*. These groups are populated by engineers from all over the world who visit Egypt to see for themselves, while at the same time pondering if they can add value to Petrie's and my work by making their own discoveries and adding their own voices.

While in Egypt in September 2021, I began to learn the extent to which *Lost Technologies* has impacted the younger generation. Many new media personalities, particularly YouTubers, are now drawing visitors to Egypt to examine its artifacts and the evidence of advanced civilizations. On September 28, 2021, I had a meeting with Hany Helal, former minister of scientific research and higher education and lead coordinator of the ScanPyramids project, and Hamada Anwar, an international law judge who is representing Egypt's legal interests in the project. Both gentlemen were extremely kind and intelligent, and I came away relieved that there is a new breed of government official involved with the pyramids, officials who

have different attitudes toward new ideas. Both have received copies of my books and expressed an interest in cooperating further.

Following my flight home, and after returning to my office to continue writing this book, I contacted a Facebook friend, Ahmed Adly, an Egyptian engineer who has done his own studies of Egyptian artifacts. I was interested in learning what his views were regarding the opinions of his peers in Egypt and if he would provide me with a quote for my book. He said he would be happy to do it and sent me a report. After reading his report, which is included in the foreword. I watched his YouTube videos and was very impressed by his presentation style, his use of graphics, and his accuracy of reporting. Considering that he is probably the most credible Egyptian researcher on social media, I am grateful that he agreed to write the foreword for this book.

Ahmed Adly's YouTube channel has several excellent videos on the subject of *Lost Technologies in Ancient Egypt*. Together with the UnchartedX YouTube channel, Adly's videos are probably the best out there, in my opinion, as they are based on Adly's genuine engineering knowledge and skills. His presentations are very thorough and objective and are becoming increasingly popular, with some attracting a million viewers. Currently, they are in Arabic, but he has told me that his plan in the future, as time allows, is to create English translations. What I learned in Egypt, combined with Adly's report, was significant. My overall impression is that there is a quiet grassroots revolution of young Egyptian professionals who are rejecting the stories of Egyptologists and are now more interested in learning about the actual lost technologies of their ancestors. They have rejected the idea that the pyramids were tombs and are willing to consider alternative, more scientifically aligned explanations for their existence. There is a strong willingness to accept the idea that the pyramids were machines.

Some comments regarding *Lost Technologies of Ancient Egypt* have expressed disappointment that I did not provide my own concept of what such machines would look like and how they would operate. To an average person, when they think of a machine, they think of large pieces of metal. Forgings and castings come to mind. They are machined and assembled with precision to perform actions that affect the condition of other materials. The heavy, cast-iron frame of a milling machine can be clearly identified as part of a machine, even if much of what was originally

attached to it has disappeared. Rusting in scrap yards across the world are metal objects that were once parts of machines that now sit patiently waiting for natural forces and time to slowly consume them or to be repurposed and shaped into other products. After how many years will they no longer exist? Five thousand? Ten thousand?

THE MACHINES OF THE SERAPEUM

It's impossible to convey the mindset that has been shaped by over a half century of work experience in manufacturing, especially if a significant portion of that time has been spent in performing the manual and mechanical activities involved in creating precision products. One cannot achieve it by reading books or watching YouTube videos, no matter how entertaining they may be. So I'm not sure if words are sufficient to provide you with the full opening of awareness I experienced when discovering the precision that was crafted into not just the boxes in the Serapeum but also Khafre's pyramid, where, upon placing a precision straightedge against the inside surface, I exclaimed, "SPACE-AGE PRECISION!" A comment for which I have been heavily criticized and sometimes mocked. Those who criticize and mock are not seeing what I see. They see an empty space, a wall of granite. Their vision ends at the surface of the granite. For a machinist/toolmaker/engineer like me who has devoted tens of thousands of hours to the creation of precise objects, any precise object that I come across can be viewed as a window to a world where knowledge, materials, and machines are orchestrated into manufacturing processes that produce a flow of products for demanding customers. The average person who uses these products is unaware of the complex yet specific range of activities that were necessary to create the products they interact with every day. The only performance they are interested in is the performance of their purchases—the product in their hand (smartphone) or the product that surrounds them (car, train, or airplane). In reality, the entire orchestration of manufacturing activity is important to them, for it affects the quality and price of their purchase.

When I first discovered the precision with which these monolithic boxes were crafted and noted that there was an unfinished box near the entrance to the bedrock tunnels, I proposed that the monoliths were finish machined and polished underground before being installed in the crypts. In this way,

changes in temperature were avoided that might affect the granite's precision if it was finished aboveground and then brought below. This level of precision is not crafted into an artifact unintentionally. It is a design characteristic that is important to the function of the artifact, and efforts are made to ensure these characteristics of precision are not subject to change. Reviewing the work of other researchers, such as Ben Van Kerkwyk of the UnchartedX YouTube channel, who was guided by Yousef Awyan, a talented Egyptian sculptor, a different picture is emerging of the full scope of activity that was taking place thousands of years ago. This picture is similar to what takes place in modern manufacturing.

Walk into any manufacturing plant and you will find a product that is in various stages of production. A rough forging or casting may be seen in one area, and in another area the rough forging or casting will have been rough machined. All of its surfaces may not be required to have the same texture and precision as the final product but will be left with enough material (stock) for the final machining to remove in order to achieve its required dimensions, tolerances, and finish. It is in what is known as a semifinished state.

The final product may have evidence of forging, rough machining, and ultraprecise machining, with the forged, rough, or not so precise regions left alone, as they are less important for the performance of the product. For instance, every surface on a forged crankshaft is not semifinished or finish machined. The crank webs and counterweights generally are not machined and keep their original forged finish.

The three states of manufacturing to remember when trying to find reasonable answers to what exists in the tunnels of the Serapeum are:

1. Rough. (As created on site or delivered by the foundry, mill, forge, or quarry.)
2. Semifinished. (As created on site or delivered by the foundry, mill, forge, or quarry.)
3. Finished. (Precisely finished on site.)

It is now revealed that boxes in the Serepeum display all three states of manufacturing. There is a rough box and lid, there are boxes contained within crypts that are semifinished and are without lids, and there are boxes

with lids, such as the one I inspected in 2001, that are finished to a high order of precision. A professional survey of the entire installation by qualified engineers is required to create a more complete picture of what the Serapeum contains and what it means.

Following the path a piece of raw material may take through various processes involving workers and their machines, the last step in the process will see the finished product inside an inspection laboratory populated by highly skilled and knowledgeable quality inspectors along with a variety of metrology instruments and machines that will be used to verify every important attribute crafted into the product. It is within this environmentally controlled area that we find part of the answer to the central question of "Where are the machines?"

In a corner of the inspection laboratory at Danville Metal Stamping, a company I was employed by for 27 years, is a large machine known as a CMM (coordinate measuring machine). The manufactured product is placed on an inspection-grade granite surface plate, and the machine is programmed to navigate three-dimensional space to determine the exact coordinates of specific features on the product using a touch probe, or laser, in order to compare the physical object with the model designed by the computer. But it is not just the manufactured product that enjoys the feel of smooth, flat granite against its surface. The bridge that carries the Y- and Z-axis travels along the X-axis, which also needs a surface upon which to travel that is flat and precise.

It is important to know that a section of the CMM's granite base also serves as a way along which a machine carriage travels. This machine carriage is equipped with air bearings and, essentially, "floats" on a thin film of air. In other words, a single piece of granite has a dual purpose in this machine. It serves as an ultraprecise reference plane upon which products are placed while at the same time serving as a precise way for the testing machine. This is an important function that traditionally has been separate from the work table upon which products are positioned and secured.

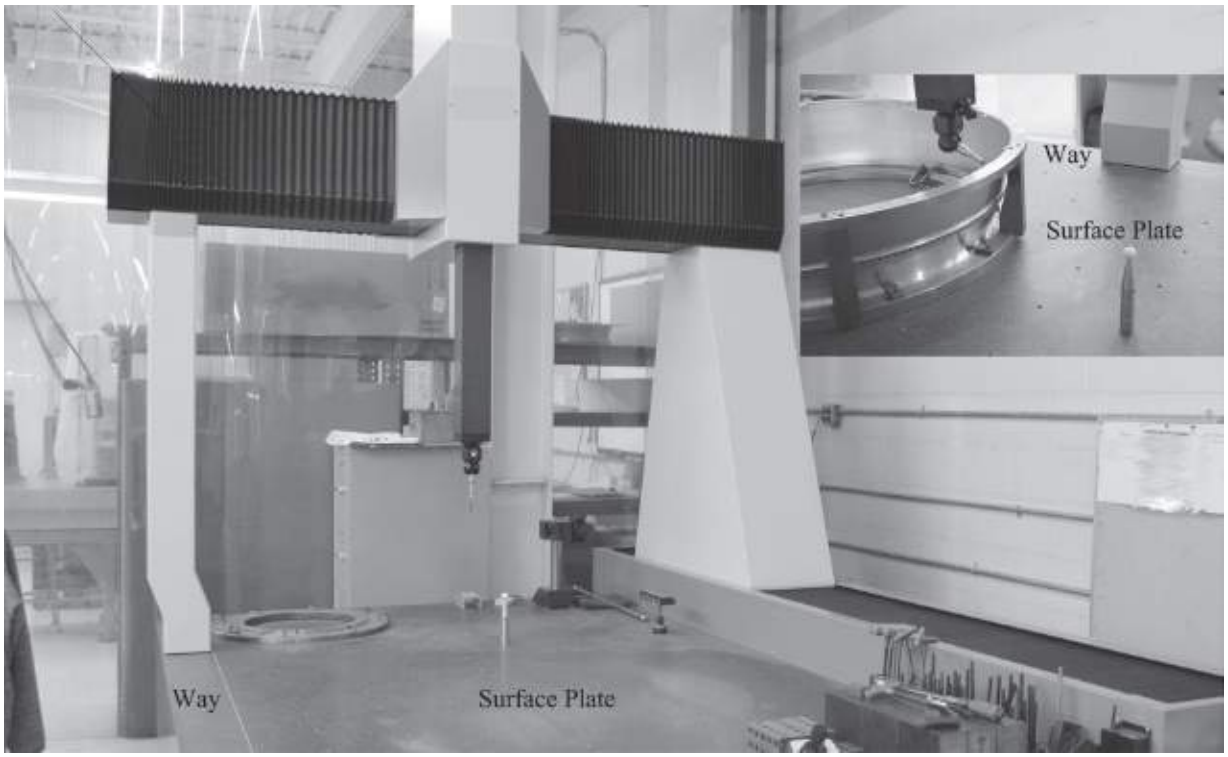

Figure 8.6. One of Danville Metal Stamping's CMMs.
Image credit: Gardner Peck (Danville Metal Stamping).

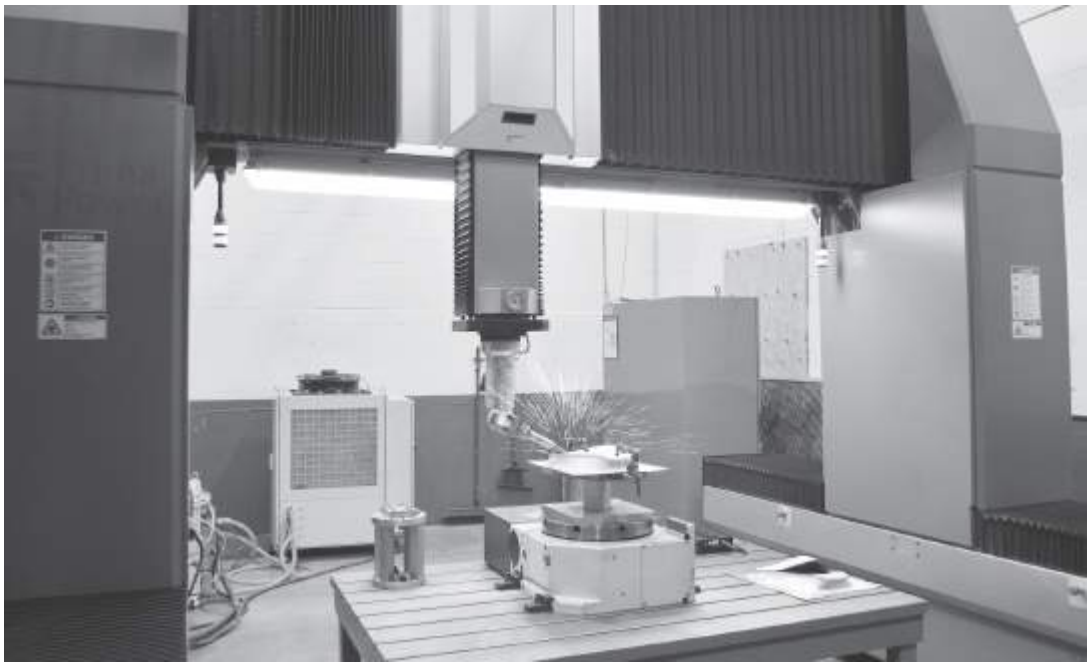

Figure 8.7. Example of machine where ways are separate from the work table.
Image credit: Gardner Peck (Danville Metal Stamping).

Before getting into the details of how this relates to the Serapeum, I would like to discuss critical information I have learned over the years about the nature of granite. This is information that a countertop installer will probably not share with you because it is not relevant to how your granite countertop looks or functions. However, it is highly relevant when crafting and maintaining calibrated precision surface plates used in manufacturing.

The granite surface plates used in manufacturing plants, such as Danville Metal Stamping, require frequent calibration by independent professionals who are contracted to inspect, resurface, and certify that the surface plate conforms to industry standard ASME B89.3.7-2013.

John Barta of Barta's Precision Granite Co. in Cleveland, Ohio, is one of these professionals, and he provides these services to companies across the Midwest. When I was working in Indianapolis, I had the opportunity to talk to Barta and pick his brain about his experience with granite. One of the most important aspects of the nature of granite that he shared with me was how it is affected by temperature. What he had learned in his career has importance to the discussion in this chapter.

Granite Is Sensitive to Heat

John Barta told me of a case where he visited a shop that had a surface plate that had somehow developed a slight bulge or crown in the center. A slight bulge could mean only microns but was enough to swell the granite so that its flat surface did not conform to required specifications. The cause of this condition, it turned out, was a single incandescent light bulb positioned above the plate. While I don't recall him saying how close the lightbulb was to the surface of the granite, what its wattage was, or how long it had been turned on, this is a subtle but important example of why large granite surface plates require an even temperature throughout the material.

When a granite surface plate manufacturer receives a piece of granite from the quarry, the granite is semifinished to machine-capable tolerances, perhaps to within .001–.005 inch (.0254 –.127 mm) and is placed outside until there is a customer's order. In this uncontrolled environment, granite is subject to changes due to the heat of summer and the cold of winter. It could be in the yard for years before an order is received, at which time it is brought into a temperature-controlled environment for final finish.

As I discussed Ahmed Adly's research in the Serapeum in this chapter, I emailed it to him to make sure I had represented him honestly and correctly. I was very pleased with his response and grateful to learn that a PhD candidate is conducting studies in Egypt on the effect that heat has on Egypt's granite monuments. He writes:

> When you mentioned the swell of the granite, it brought me to another. Around 6 months ago, Mrs. Rabab Abd Elhakim, a teaching assistant and a PhD student in the Faculty of Arts, Geography Department of Mansoura University in Delta, Egypt sent me her Master's Thesis, with Title "Thermal extremes and their effect on Ancient Egyptian monuments." In one of the chapters, she carried out an interesting simulation experiment to study the effect of heat on color and size of the stones by bringing several rock types, mudbricks, limestone, diorite, granite . . . and other types that were commonly used in ancient Egypt, putting them in a closed Venticell oven for 12 hours continuously, setting it to 50° C (simulating Egypt weather). With measures before and after the heating process, she recorded an expansion in the stones and rocks (Mudbricks: 100 microns, Marble: 10 microns, Diorite: 10 microns); for other stone types, no changes were recorded. However, in a later phone call with her, she mentioned that longer periods are expected to have an impact on the form and size of granite, and she addressed many evidences in her thesis from Komombo temple and many other sites in Upper Egypt specifically due to its hot weather, where several granite statues and blocks slowly expanded then its surfaces started to crack and disintegrate. Yes, this point was overlooked by many, thanks for bring it up. (Ahmed Adly, email to author, June 15, 2022)

Granite Has Memory

The granite that was being held in the surface plate manufacturer's yard has changed shape many times through seasonal hot and cold cycles and needs to adjust to the temperature required for the use of laboratoryor inspection-grade surface plates before final lapping can take place. This is where, for want of a better word, its "memory" comes into play. After being brought

inside to a controlled environment and after sufficient time, the granite will return to the same shape it was before being placed outside.

And this is where it gets interesting. In more ways than one, the precisely crafted modern CMM sitting in a manufacturing plant in the American Midwest shares its "DNA" with the millennia-old, precisely crafted monoliths of ancient granite housed in the mysterious, dusty bedrock tunnels of the Serapeum at Saqqara, Egypt. The mystery surrounding the question, "Where are the machines?" can be partly answered by assuming that the most important structures and foundations of the machines that applied the final finish to the inside surfaces of the monoliths in the Serapeum are *the boxes themselves*.

When a high level of precision is required in the final product, temperature is critical when transferring a finished article from one place to another. As with a piano that requires tuning after being moved, a surface plate needs to be recalibrated. With this in mind, the answers to the question regarding the kind of machinery that was employed in the finish machining and polishing of the monoliths become clearer, and all the evidence indicates that the granite boxes in the Serapeum received their final finish and calibration *after* they were placed in the crypts.

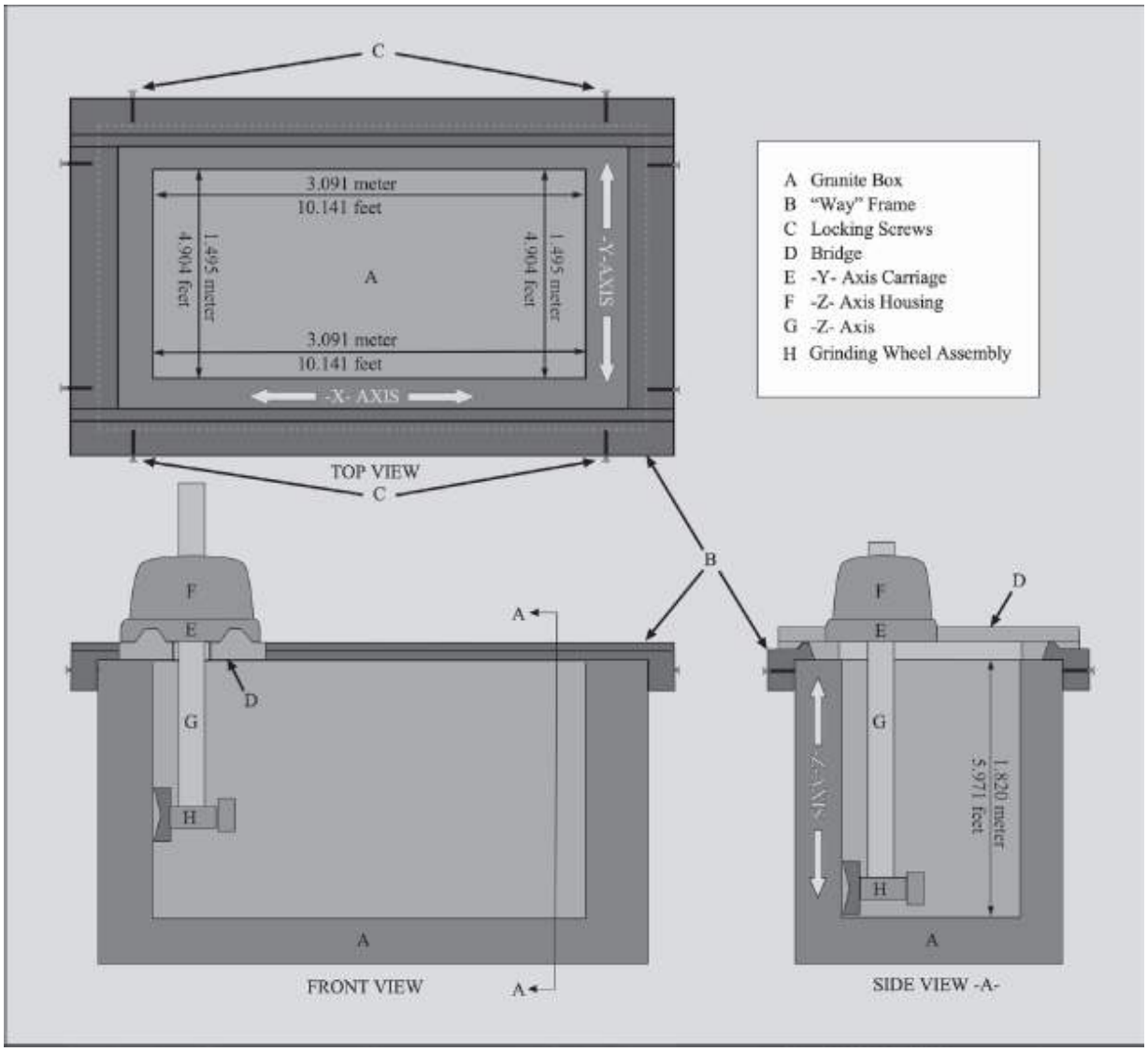

Figure 8.8. Anatomy of a Serapeum machine.

We know the Egyptians were capable of creating ultraflat surfaces that had no other features that would obstruct their lapping plates—the underside of the lids and the top surfaces of the boxes are evidence of that—but what about the inside surfaces of the boxes? The simple answer is that the top surface of the boxes could have been used as precision ways, like the CMM, upon which a superstructure comprising a bridge riding on bearings navigated along the length of the monolith.

Assume that this bridge was traveling along the X-axis. The bridge was equipped with another precision "way" upon which a carriage traveled in the Y-axis. A vertical structure mounted on this carriage, known as the Z-

axis, was equipped with the tools necessary for grinding the interior of the box. The tool used to cut the surface may have been a circular grinding wheel that was able to be indexed in 90-degree increments around a rotary axis, typically identified as the A-axis. In this manner, the face of the grinding disk can grind each interior wall of the box. Also, the task of creating a square corner with a small radius where adjacent surfaces meet is easier to accomplish. However, a feature left in the bottom corner of one of the boxes seems to open the possibility that grinding tools with different geometries may have been used.

The corner at the bottom of this box, seen in Figure 8.9, is left with a feature that one would normally identify as a gusset that provides extra strength between two or three tangent surfaces. However, it also poses several other questions regarding why it is there and how it was created:

Figure 8.9. Unusual feature in bottom of Serapeum box.
Image credit: Ben Van Kerkwyk.

- Does it reflect the shape of the tool that was used to cut the box?
- Observing that the adjacent surface does not appear to be perfectly flat, is the box in a semifinished state and will this feature be removed in final machining?
- Do other boxes have this feature in them?

Preliminary examination of the interior of these monoliths indicates that ultraprecision at the bottom was not required. In the box I briefly examined in 2001, the precise flat surface I noted near the lid is not present near the bottom.

There may be a reason for this if we try to answer the question, "Why were these boxes made so precisely?"

It has become clearer now that the ancient Egyptians were very advanced in their knowledge and use of sound and vibration and used that knowledge to affect their environment and way of life. A possible reason that it may have been necessary to install the monolithic boxes inside a recess in the middle of the crypts is that they were subject to vibration and, if not contained, they could move out of position.

If the boxes were stimulated to vibrate, then for what reason? Also, considering the geometry and precision of the inside surfaces, I'm compelled to ask, "Did the inside of the box serve as a resonant cavity?" An example of a resonant cavity is a laser, where parallel mirrors serve to amplify photons that are released when energized electrons are stimulated to return to their natural orbit around the nucleus of an atom.

Considering that the walls of the Serapeum box cavities are parallel and square to each other, what conditions would affect a medium within the cavity, whether that medium is a gas or a liquid? There is no denying the testimony of hundreds of tourists who have lain down inside the resonant granite cavity known as a sarcophagus inside the King's Chamber of the Great Pyramid. When the box is struck, or a particular frequency of sound is directed into the cavity, the person lying in it feels something they have never felt before. Recall the descriptions from my Facebook friends regarding their experiences (page 80).

There is no clear and definitive answer to the question, though the idea does shed some light on why the bottom of the cavity is not as precise as the upper section. Because the box is made from a single piece of granite, it has a thick bottom, and any vibration in that area would be dampened. Therefore, all the vibratory action would be in the upper part of the walls. Another reason why the bottom of the boxes' interiors may not have required the same care and precision as the upper parts is even more mind-blowing when considering the input from a variety of sources.

On my Lost Technologies of Ancient Egypt tour in 2018, I entered the Serapeum with my group, which included aerospace engineer Eric Wilson.

His idea regarding a possible function of the boxes was that they were used to grow crystals. During the preparation of this book, I reached out to Eric to ask him if he still supported that idea. Remarkably, he responded that he not only still thought it was a possibility, but further insights as to what may have been going on there were shared with him by a New Zealand friend, Lauren Kurth, when they both visited the Serapeum in 2020. Lauren suggested that the boxes may have been surrounded by water that was heated to a certain temperature, and this would have helped with the growing of crystals.

I must admit, I was blown away by such an imaginative idea because it resolved other questions that I have had in my mind since first visiting the Serapeum in 1995. Eric and Lauren's insights provide a possible solution to the mystery of why the granite boxes are placed in a recess within a chamber that is cut below the surface of the tunnel floor. They also open a new path of inquiry into the manufacturing steps that were taken in crafting the boxes and the critical considerations of how precision can be maintained in granite if it is kept at a specific temperature.

TAKING THE PATH TO PERFECTION

- Specifications are given to the quarry to deliver a piece of granite with sufficient material left to remove in order to achieve final dimensions.
- Granite is received, brought into the tunnels, and receives semifinish machining. The granite may be precise to within 0.100 inch (2.54 mm) with material left for final finishing.
- The boxes are installed in the crypts prior to final machining.
- The lids are semifinished, with the exception of the underside, which is finished flat to a high level of precision.
- When surrounded by water of the correct temperature for an appropriate amount of time necessary for the granite to acclimate, the top of the box is finished flat, with all four sides being on the same precise plane.
- An attachment similar to the one illustrated in Figure 8.8 is securely mounted on the top surface, and the insides of the box are precision machined and lapped to achieve the specified finish and tolerances.

The box is now ready for use. The question is, “What was it used for?”

While working for an engineering company in Indianapolis in the mid-1970s, one of my projects was to manufacture an electrophoresis plating machine. It was used to apply ceramic material that was suspended in water to turbine blades, creating a thermal barrier. One of the features of the machine was a shaft with blades on the end that almost touched the bottom of the tank. These blades rotated very slowly, their purpose being to stir the material that sank to the bottom of the tank, keeping it suspended in the liquid and preventing it from settling on the bottom.

With the Serapeum boxes, we might be able to create all the necessary conditions to grow crystals. A large vessel is caused to vibrate but is prevented from moving due to being inserted in a recess in the floor. The large vessel is kept at an even temperature by surrounding it with water of the optimum temperature—which explains the crypt floor being below the tunnel floor. The questions that remain, though, are: “What kind of crystals, and what results were expected that required the vessel to have perfectly flat and parallel inside surfaces?”

ENGINES OF CREATION AND THE SERAPEUM

Past until Present-Day Manufacturing

Past and present manufacturing has been and is based, principally, on reductive processes. Material is made by combining elements in a furnace, the results are poured into molds, and various processes turn the material into different raw material products. The raw material is received by a manufacturer and then shaped by diverse means, some of which include the removal of material using specialized machines.

Present and Future Manufacturing

Currently, the introduction of computers and sophisticated software has, in some cases, allowed greater efficiency and results. What are known as additive technologies are now being used for creating products that were previously manufactured in the traditional manner. Some jet engine parts are now being made with a 3-D printer using a laser that fuses material that is continually added in discrete amounts in a precise location in three-dimensional space.

To travel further into the future, conceivably we are now beginning to explore the territory occupied by the creators of the Unidentified Arial Phenomena that dazzle and baffle us with their gravity-neutralizing, amazing demonstrations of flight. What advances in manufacturing did the civilization that conceived of and produced these machines make? It might help if we reach back into the past a quarter of a century and revisit the visionary work of K. Eric Drexler.

In 1986, Drexler authored a remarkable book titled *Engines of Creation: The Coming Era of Nanotechnology,* about which the following was written by the publisher: "*This brilliant work heralds the new age of nanotechnology, which will give us thorough and inexpensive control of the structure of matter. Drexler examines the enormous implications of these developments for medicine, the economy, and the environment, and makes astounding yet well-founded projections for the future.*" (Drexler 1986)

"OK," you may ask, "what does all this have to do with the Serapeum?" I would answer perhaps nothing—perhaps everything. At the risk of it being nothing, and the possibility of it being everything, I cannot ignore what Drexler said about how, using nanotechnology, an aircraft engine could be assembled one atom at a time by what he described as microscopic "universal assemblers."

Drexler's vision of how nanotechnology could be developed and applied covers a broad range of activities in the medical and manufacturing field. If you asked Drexler the question, "Where are the machines?" he would describe a machine so small you would not be able to see it with the naked eye.

Similarly, if Dustin Carr invited you to a concert that featured a forty-piece orchestra, on arriving at the concert hall you would ask, "Where are the instruments?" Carr's nanoguitar, created in his lab, is so small you would need an electron microscope to see it, and when played, the subtle energy and precision of a laser beam impacting the strings would cause them to vibrate at a frequency you would be unable to hear. If the rest of the orchestra were built that way, there would be no noise complaints from his neighbors.

Universal Assemblers

Drexler describes universal assemblers as "second-generation nanomachines" that are built on a microscopic scale to perform an additive

manufacturing function that can build complex structures one atom at a time. Unlike a 3-D printing machine in which the grains of different elements are fused together, nanomachine universal assemblers would be programmed with all the information they needed to select a specific atom from the environment, bond with the atom, and transport and deliver it to a precise location where it is caused to bond with atoms already connected to the structure that is being formed. Drexler points out:

> Because assemblers will let us place atoms in almost any reasonable arrangement, they will let us build almost anything that the laws of nature allow to exist. In particular, they will let us build almost anything we can design—including more assemblers. The consequences of this will be profound, because our crude tools have let us explore only a small part of the range of possibilities that natural law permits. Assemblers will open a world of new technologies. (Drexler 1987, 14)
>
> In everything I have been describing, I have stuck closely to the demonstrated facts of chemistry and molecular biology. Still, people regularly raise questions rooted in physics and biology. These deserve more direct answers.
>
> –Will the uncertainty principle of quantum physics make molecular machines unworkable?
>
> This principle states (among other things) that particles can't be pinned down in an exact location for any length of time. It limits what molecular machines can do, just as it limits what anything else can do. Nonetheless, calculations show that the uncertainty principle places few important limits on how well atoms can be held in place, at least for the purposes outlined here. The uncertainty principle makes electron positions quite fuzzy, and in fact this fuzziness determines the very size and structure of atoms. An atom as a whole, however, has a comparatively definite position set by its comparatively massive nucleus. If atoms didn't stay put fairly well, molecules would not exist. One needn't study quantum mechanics to trust these conclusions, because molecular machines in living cells demonstrate that molecular machines work. (Drexler 1987, 15)
>
> To have any hope of understanding our future, we must understand the consequences of assemblers, disassemblers, and

> nanocomputers. They promise to bring changes as profound as the industrial revolution, antibiotics, and nuclear weapons all rolled up in one massive breakthrough. To understand a future of such profound change, it makes sense to seek principles of change that have survived the greatest upheavals of the past. They will prove a useful guide. (Drexler 1987, 20)

To have any hope of understanding the full scope of the Serapeum and what it was used for, we must not only look into the past but project our minds into the future. Some people in the world are more adept at doing that than others. One of them is my friend, Arlan Andrews Sr. Through our mutual interest in pyramids, I first met Andrews in Indianapolis when he was working for Bell Labs in the late ’70s. This was during the time I was working on *The Giza Power Plant*. In 1986, Andrews excitedly introduced me to Eric Drexler’s *Engines of Creation,* and we spent many hours discussing its ramifications.

In 1989, Andrews left Indianapolis for Albuquerque, New Mexico, to work for Sandia Laboratories, and while there, in April 1991, was selected by the American Society of Mechanical Engineers (ASME) to serve as a Fellow in the Technology Administration Office at the Department of Commerce in Washington, DC. Following this assignment, in January 1992, he joined the Office of Science and Technology Policy (OSTP), a group of scientists and engineers in the White House Science Office, which is housed in the Eisenhower Executive Office Building next to the White House. Their mission was to advise the president on emerging technologies and what their implications were for changes in society and, particularly, consequences that could impact national security. While there, in November 1992, he founded a science fiction think tank named SIGMA.

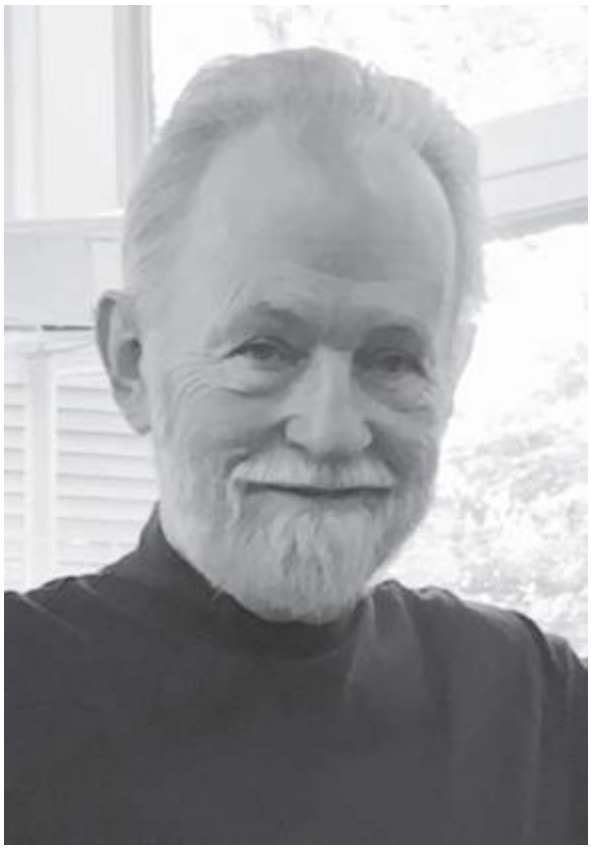

Figure 8.10. Arlan K. Andrews Sr.
Image credit: Arlan Andrews, ScD.

That same month, Andrews invited Drexler to attend a meeting with OSTP staff and the director of the National Science Foundation. Following that, he wrote the first White House endorsement of molecular nanotechnology for the report, Science and Technology—A Report of the President to the Congress 1993. In the chapter "Manufacturing—The New Competition," Andrews discussed future developments in aggregation (additive) processes—then called 3-D faxes and now known as 3-D printing; microelectromechanical systems—today's tiny robots; and molecular manufacturing—Drexler's nanotech concepts.

Inspired by Drexler's book on nanotechnology, Andrews wrote a short story for the science fiction magazine *Amazing Stories* (May 1989) entitled "A Visit to the Nanodentist," in which he described a world in which dentists were using nanotechnology to restore teeth to their natural state. The molecular machines were specifically designed and programmed to remove decay and rebuild the tooth with the correct material, one atom at a

time, while at the same time the cells of the surrounding gum tissue were repaired. Carrying on the theme of future nanotech applications, Andrews's later novel *Silicon Blood* (Hydra Publications, March 2017) imagines a society where the same advanced technology is used to create a new drug cartel.

On March 17, 2017, an article appeared on CNBC's website titled: "Mini-nukes and mosquito-like robot weapons being primed for future warfare" (Daniels 2017). The next day, Andrews shared the article on his Facebook page, with the following comments:

> In 1991, at a table in the cafeteria in the Old Executive Office Building, I was telling other Fellows and a woman guest about Eric Drexler's Nanotechnology Conference in California I had just attended, as a Fellow in the Technology Administration of the Dept. Of Commerce.
>
> "What could that technology be used for?" my friend's guest asked. I replied, "Well, imagine a flying robot the size of a housefly zooming into the Oval Office a hundred yards from here, sitting on the wall with full video and audio sensors." She thought for a moment. "Send me a copy of your trip report, please."
>
> After she left, I asked who she was, not recognizing her name. "Oh, she's the ex-wife of [a famous science fiction writer] and is with The Agency." A month later I was invited to a CIA symposium on nanoelectronics. (Arlan Andrews, Facebook post, March 17, 2017)

Thinking Outside the Box

In general, people who think outside the box are admired and encouraged for their ability to imagine creatively how to improve society. Once the fruits of their imagination are brought into reality, a new and different box is created that defines and controls the activity that sustains the replication of their creations.

One might think that when an out-of-the-box thinker defines the parameters of a new box, their new box is much larger than the one they stepped out of. As a matter of physical size, the out-of-the-box, redefined new box does not necessarily get bigger. Bigger is not always better.

Boxes within which aircraft and rocket engines are created today cover thousands of acres. Foundries, manufacturing plants engaging in specialized parts production, assembly plants, and warehouses dot the landscape across the planet. Within these boxes, sometimes known as gigafactories, are smaller boxes, virtual or physical, where humans and machines perform specific functions within defined parameters. The humans entering the plant know where to go and where their "walls" are located, and they perform their work within those walls, using the tools and training provided to them. Drexler writes: *"A sprawling system of factories staffed by robots would be workable but cumbersome. Using clever design and a minimum of different parts and materials, engineers could fit a replicating system into a single box—but the box might still be huge . . . "* (Drexler 1987, 55).

Drexler's vision for creating rocket engines using nanotechnology would shrink all those existing boxes that are necessary to produce the engine down to the size of a single large box. The 1970s prediction of how humanoid-robot-operated lathes would function in the future, and the reality of what exists today, are proof that predictions do not always manifest as they are described. In the case of the humanoid-robot-operated lathe, what came to pass was far greater than what was predicted. Will we say the same about Drexler's prediction that nanotechnology will transform not just manufacturing but every other field that influences human existence on this planet? It stretches the boundaries of imagination, and I cannot imagine it being outshone when it is brought into reality. But if history teaches us anything, it is that future generations will improve whatever we can imagine and create, with their own imagination and research, something that is far greater.

History has shown us that Drexler is on solid ground when he predicts that the machines we currently use to achieve an end result will be replaced by much smaller devices achieving greater results. In the early nineteenth century, Charles Babbage (1792–1871), an English mechanical engineer, conceptualized and created the world's first mechanical computer, and some consider him to be the father of computers. Babbage's difference engine and analytic engine were large machines made up of thousands of precision machined mechanical parts, such as shafts, rods, gears, cams, and pegs (Babbage et al. 2012). What these massive machines accomplished is now achieved using a mere fraction of the capabilities of the smartphones we now carry around in our pockets.

Let's Take a Walk on the Wild Side

The smaller, but still huge, box in which Drexler imagines that manufacturing can take place in the future contains raw materials and workers. The raw materials are the elements found in nature and their atomic content. The workers are assembler nanomachines that are programmed to select an appropriate atom and bond it with others within a predetermined structure. Before they have been set to work building a jet engine, their nano cousins have assisted materials scientists and engineers in creating new materials that are specific to providing the optimum operation and output of the engine they are building. These new materials provide both hardness and strength, with greater resistance to heat and corrosion.

The elements from which the jet engine is created are customized for the demands put upon each particular part of the engine. For instance, the hot section of the engine's single crystal combustor may be constructed using material that includes ceramic elements, such as aluminum oxide, silicon carbide, and tungsten carbide. The combustor is bonded to the rest of the engine without welds, bolts, or rivets, but transitions seamlessly with a crystal lattice structure made up of creative and functional pathways for efficient cooling and fuel delivery. Discussing the creation of an advanced rocket engine built by universal assemblers, Drexler notes: *"Compared to a modern metal engine, the advanced engine has over 90 percent less mass"* (Drexler 1986, 62).

When the engine reaches the end of its life cycle, it is quickly replaced with a new one and sent back to the box from where it came, where the nanoassemblers/disassemblers will restore it to its original condition.

Please note: The above scenario is based on current common knowledge of the materials that are used in twenty-first century engines. I would be surprised if future advances in nanotechnology and materials science did not make current materials obsolete.

Know Your Place: Back to the Serapeum

As new arrivals on this planet, we begin life not knowing our place. From an early age until the end of our lives, we occasionally "take a walk on the wild side" and may still not know our place, but that is not because we have not sought it out or our fellow humans have not tried to show it to us. Knowing your bearings is critical for the successful navigation of space,

whether it is off this planet or within the precise three-dimensional Cartesian coordinates inside the boundaries that define a work envelope on a CMM.

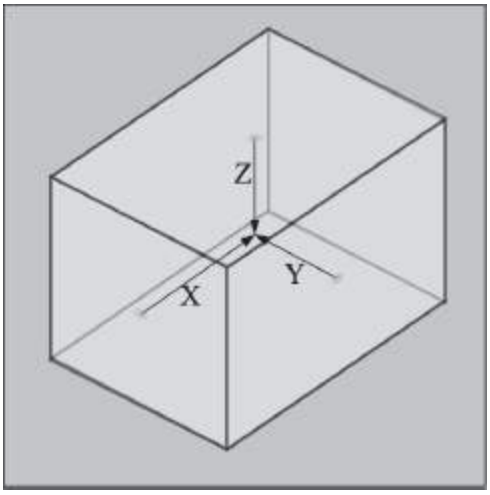

Figure 8.11. Example of a Cartesian coordinate system.

When we enter a factory as a worker, we are shown our place and taught how to behave and work within the parameters that define it. Within the work envelope of a CMM, the ruby ball tip of a touch probe is shown its place in three-dimensional space to within a fraction of a hair's width. That precise position is given as distances from an X0, Y0, Z0 absolute home point established by the machine, or a relative home point set by the operator. (See Figure 8.11.)

If we wish to build a perfect environment in which assemblers can successfully perform their job, there is no more perfect example than the boxes in the Serapeum. Let us see how this would work.

- The walls and underside of the lid define a Cartesian coordinate system within which the assemblers "know their place." (See Figure 8.11.)
- The bottom of the box is not a part of the coordinate system, as it will hold the materials that are used in the build. Therefore, exact precision is not required in that area.
- The outsides of the box and lid are not part of the coordinate system, so they do not need to be crafted with exact precision.

- The dimensions between the inside walls of the box can vary, as the coordinate system can be defined for each individual box by whatever dimension is finally achieved after critical attributes are met.
- The boxes are installed in a recess in the floor of the crypt so they do not move out of place when subject to vibration necessary to "unsettle" or mix the raw materials that otherwise would settle at the bottom.
- The boxes are installed in a space that can be filled with water that is heated or cooled to the required temperature.
- The temperature of the box is determined by the temperature at which the universal assemblers best perform their work, and the box is finished in situ at that temperature.

While discussing my observations of the precision found in the box I had tested using precision tools, I was challenged by one person to consider that my observations may not be accurate because the surface of these boxes may have a buildup of verdigris—a patina—that had accumulated over the centuries. I asked the person how thick the verdigris would be. He guessed that it might be 0.0005 inch (.0127 mm) thick, which is one-fifth the thickness of a human hair. My response was to ask him how flat a perfectly flat surface that had a coating of verdigris of .0005 inch thick would be then? I didn't get an answer.

Notwithstanding this person's motives behind the question, it raised a very important point that has now become more relevant. When considering how to communicate with the assemblers so they know where they are within a coordinate system, is it enough just to have passive, solid, flat surfaces of granite? Perhaps the walls and lid of these boxes were coated with an active material that could signal where it was located, and the universal assemblers could interpret those signals and know exactly where they were within that space at all times.

In his foreword to this book, Ahmed Adly describes the discovery of a previously unopened "sarcophagus:" "*Alessandro Barsanti explored the great pit of Zawiyet el-Aryan pyramid. Under 65 feet (20 m) of large blocks, he found a sealed giant granite sarcophagus. On removing the lid they found it was empty, except for black material that lined the side walls."*

Barsanti also noted that this so-called sarcophagus was "polished like a mirror," while on one occasion his companion, Alexandre Moret, noted, *"a splendid lid with four handles covers it, polished like a mirror and as carefully finished as an exquisite jewel."*

Today, Zawyet el Aryan is on property occupied by the Egyptian military, so it is off limits to tourists. Nevertheless, it is one of many sites that deserves thorough examination through the lens of advanced manufacturing. It is not, however, the only site that houses granite boxes with a black substance inside. It has been reported that at least one such box is located down the Osiris Shaft under the Sphinx causeway. I have not personally witnessed this but mention it in the hopes that it will inspire further investigation by professionals with a background in chemistry.

When discussing the building of a rocket engine, Drexler describes a system in which assemblers not only know their place but receive instructions on what to do. Similarly, when entering a factory to perform work, workers will be told where to go and what to do when they get there. Drexler describes a "seed" that contains a nanocomputer being located at the center of a base plate upon which the engine "grows." Stored in the nanocomputer are the plans for the engine. When the assembler needs to reorient itself and receive a new set of instructions, it plugs into the seed by sticking to it: "Since each assembler knows its location in the plan, it snags more assemblers only where more are needed. This forms a pattern less regular and more complex than that of any natural crystal. In the course of a few hours, the assembler scaffold grows to match the final shape of the planned rocket engine" (Drexler 1986, 61).

From Rocket Engines to Cutting Tools

Universal assemblers would not only be used for rocket or jet engines. Other products that would benefit from the advanced materials that these nanomachines produce could also be manufactured. Today, diamond is ground into small pieces that are sintered into metal and used for grinding. With nanotechnology, diamonds could be joined with other elements and be assembled into innumerable products, one of them perhaps being used to efficiently cut hard igneous rock.

Achieving Manufacturing Nirvana and the Return on Investment

To have just one box quarried, delivered, rough machined, semifinished, and finally finished in the crypts in the Serapeum would be enormously expensive. Three of the four precision granite manufacturers that I contacted failed to provide me with a quote for making one. Tru-Stone in Minnesota said they did not possess the equipment to produce one out of a single piece of granite but offered a plan where they would create the box using five individual pieces that could be bolted together after being delivered.

This has prompted some researchers to say that these boxes could not be made today. I disagree. They most certainly could be made today, but they would be very, very expensive. How expensive? I really don't know how many zeros to put in that number. Also, in order to spend those multiples of zeros, one would need a very good reason for it and the return on investment would be an important factor that would support the reason.

A very good reason could be that the Serapeum was created to serve as an advanced, state-of-the-art manufacturing facility. What was produced there brought value to the producers that would pay for their investment many times over. These products could be created in ways that we can only dream about and perform tasks that we are just now beginning to recognize as being able to exist.

But now as I find myself further out on the limb, I must return to address the skeptics who have accused me of fudging and faking measurements, without even considering that there may be valid reasons for the existence of precision and nonprecision that would save them the trouble of defaming a fellow researcher.

Once an area of an artifact is discovered to not be as precise as another area, the skeptic draws your attention only to the inaccuracies, as if that defines the artifact. With respect to this well-used logical fallacy—known as *post hoc, ergo propter hoc,* where a conclusion is reached based on one data set while other data sets are dismissed and ignored—there are two major points I would like to make. Every manufacturer understands them. It's not rocket science and can be learned by anyone who is willing to expand their understanding of a field within which they have no experience.

- High precision and low precision can and do coexist on the same manufactured item.

- The area on a manufactured item that is the most precise is more important to the customer than the area that is less precise.

For example, the granite surface plate upon which a CMM navigates is required to be calibrated periodically. This is performed by specialists like John Barta, who has decades of experience performing calibrations and resurfacing of inspection plates of all sizes. When observing this kind of specialist perform their work, if they strayed from the area that they were supposed to be calibrating and began to inspect the edges, the underside, or used a square to check the corners, one would be right to conclude that they were wasting time and did not know what they are doing.

And yet, we now have skeptics and debunkers traveling to Egypt to film in the Serapeum for the purpose of creating heavily monetized YouTube videos in which they accuse me, without evidence, of lying, fudging, and faking. There was no faking and fudging. I used inspection tools I was familiar with and had used successfully for many years. I applied these inspection tools to the inner surfaces of a granite box in the Serapeum and two photographs were taken (shown in figure 8.1 on page 185).

I can, and have, shown experienced toolmakers/machinists/engineers these photographs, and the only explanation I give is where the artifact is located. Nothing more needs to be said.

Similarly, thousands of similarly trained specialists around the world have recently been riveted to learn on the UnchartedX channel the latest discoveries that have been made pertaining to the predynastic Egyptian vase discussed in the Introduction.

Figure 8.12. Tools of the trade. Are these fudged or faked?

I challenge all skeptics to come forward to present their evidence and provide answers to the following questions:

- Which measurements do they object to?
- How were they fudged or faked?

EVIDENCE OF COMPUTER GUIDED MACHINES IN ANCIENT EGYPT

When it comes to crafting precise artifacts out of igneous rock, the observation that ancient Egyptians used machine technology was first proposed by Sir William Flinders Petrie in 1883. My article in the August 1984 edition of *Analog Science Fiction and Fact* expanded on Petrie's work, but in hindsight was timid. That article, "Advanced Machining in Ancient Egypt?" had a question mark at the end. Then, in *Lost Technologies of Ancient Egypt*, I presented additional evidence that prompted me to remove the question mark. Now, in 2023, through the efforts of other researchers, I can confidently place an exclamation mark where previously

a question mark held sway! Yes, there *was* advanced machining in ancient Egypt!

I strongly advise the reader to access and read Mark Qvist's article "Abstractions Set in Granite" on his website, Unsigned.io. It is discussed in detail later in this chapter and I have also made it available on my website, Giza Power. Those who may think I did a fair job of describing ancient Egyptian machining will find that this research is light years ahead of what I was able to accomplish. I can only imagine what the next fifty years will reveal.

The Egyptian Vase Scanning Project

The inspection of Egyptian vases was initiated by Adam Young who from an early age had an interest in the ancient Egyptian culture and antiquities. This interest in his formative years quickened in 2010 when he and his wife, Emily, watched the "Pyramid Code" five-episode documentary series by Dr. Carmen Boulter (1954–2022), and he became impressed with a legendary figure who lived in a village called Nazlet El Samman near the Giza Plateau. Tall, gentlemanly, and charming, Abd'el Hakim Awyan (1926–2008) was blessed with a gift for relating native wisdom he had gathered over a long lifetime of guiding visitors around the pyramids and up the Nile, Hakim had gained quite a following of admirers around the world and spent some of his time visiting various countries giving lectures.

After Hakim's passing, his family continued his tradition of guiding visitors through Egypt, and his son, Yousef, a talented sculptor, now tours with Ben Van Kerkwyk of UnchartedX. Adam reached out to Hakim's family and joined one of their tours, which he remembers as a "life changing" experience.

I asked Adam what prompted him to build a collection of ancient Egyptian vases. He said, "from traveling with, and speaking to various Egyptologists and independent researchers, it was clear that the remnants of a vast and sophisticated body of knowledge were still present. Whatever happened in the distant past, there is not much physical evidence left, but we can see the results of precision engineering in granite and diorite stonework all throughout the world. We see it in large megalithic works such as the pyramids and other monumental structures, but we also can find it in the smallest works, such as granite vessels* and other objects."

Adam then actively searched for these vessels on the antiquities market. He remarked that it has become harder recently to find them, due to a greater interest now being shown than before. But, he notes, there may be more than a hundred thousand of these artifacts in private and public collections around the world.

In 2018, Adam joined my Lost Technologies of Ancient Egypt tour and became friends with my son, Alex. During that time they discussed taking some of Adam's vases and subjecting them to the same examination manufacturers use to inspect the quality of complex machined parts. Alex worked in the quality department at a defense contractor in Indianapolis, so it was arranged for Adam to fly to Indy with his vases and subject them to traditional well-known and accepted mechanical methods for inspecting roundness, flatness, and concentricity.

I was a witness at that time and was quite surprised at the precision that was revealed when a quality inspector, with the vase mounted on a precision rotary table, and using an Interapid indicator, revealed a bore diameter that varied a mere 0.002 inch (0.050 mm). Other features, such as the top and bottom flat surfaces, the body diameter, and the lugs were similarly precisely round and concentric, to themselves and each other.

Adam and Alex's enthusiasm over these results cannot be questioned. To quote Adam, he said, "The results here speak to a fully-developed design and manufacturing system capable of mass production—using some of the hardest materials on Earth. These vessels are simply not possible to create by hand."

While I agree wholeheartedly with that statement, in the back of my mind was a certain degree of skepticism and concern about how far this could go in providing more proof of advanced machining in ancient Egypt. I was concerned about the item's provenance and was quite aware that skeptics would use this same concern to reject the item as not being authentic. At the same time, there would be arguments made that the vase was a forgery and manufactured using modern machine-tools.

Not daunted by such concerns, both Alex and Adam were inspired by these preliminary findings and made plans to expand the scope of their research to include an inspection method that was just being introduced into Danville Metal Stamping before I retired at the end of 2012, but one which Alex had received training in and performed on a daily basis in his job. That is structured light 3-D scanning. This technology, which is common today,

acquires millions of data points on the surface of an artifact to create a point cloud out of which an STL file can be generated. (“An STL file describes a raw, unstructured triangulated surface by the unit normal and vertices (ordered by the right-hand rule) of the triangles using a three-dimensional Cartesian coordinate system.” (Wikipedia). The STL file can then be analyzed in CAD software where geometric elements can be recognized and analyzed for size, form, and relationship to other elements.

Adam returned to New York with his vases, intent on taking them the next step. He said, “The quickest way to seeing the current narrative change (in my lifetime) is by embracing big data and AI. Hard data is irrefutable, but we need to centralize as much as we can to make any real statistical or analytical work possible. To that end, the goal is to scan as many ancient artifacts as possible. There is no other way in my opinion.”

It was not long after Indianapolis before Adam had secured the services of Capture 3-D, a Zeiss company in South Windsor, Connecticut, who scanned a vase and provided him with the resulting STL file. Adam provided the file to Alex, who then collaborated with a coworker, Nick Sierra, a Purdue University graduate working in the metrology department of a composite specialty aerospace manufacturing company in Indianapolis, who performed an analysis in the PolyWorks CAD system.

After holding the results of their analysis for some time, Alex got in touch with Ben Van Kerkwyk of UnchartedX and described the project. Ben then invited Alex, Adam, and Nick on his podcast to present their findings. The comments section on Ben’s YouTube channel became very active following the release of this video, with many commenters identifying themselves as machinists, toolmakers, and engineers with decades of experience claiming that the vase could not be made today. I had always thought that those who make this claim may be exaggerating, or not informed of the capabilities of modern engineers, but this flood of qualified opinions on the subject was impressive and persuasive.

Adam Young thought so too, and said, “It is heartening to see the sheer number of qualified engineers and scientists becoming interested in the subject. This is exactly what was lacking from the field of archaeology. This is how change will happen.”

Prolific author and researcher Ralph Ellis emailed me his unreserved opinion of the vase. He writes, “One thing is for sure, Alex has proved this

is not a recent forgery. No forger would go to this level of precision . . . !" (Email received on March 6, 2023)

Some, but not all, of my reservations about the artifact had been eliminated.

Particularly, the one feature of the vase that struck me was that its body closely matched the shape of an ellipsoid. In *Lost Technologies of Ancient Egypt*, I had identified the use of ellipses and ellipsoids in the design of statues, crowns, and temples in and around Luxor, commenting that in our history, credit for mathematically describing the ellipse was given to the Greek mathematician, Menaechmus, (380–320 BCE).

This vase, therefore, contained at least two attributes that I had previously pushed back in time and accredited to ancient Egypt: precision machining and the ellipsoid.

Following the interview with Ben, there were many requests from engineers to have the STL file available to the general public, so engineers all over the world can perform their own analysis and report their results. In considering this request, the team agreed to make the STL file available for download, arguing that data obtained from ancient artifacts should be "open source" because all inhabitants of the planet have a vested interest in the truth about their ancient ancestors. The desire was that full transparency should exist during this process, and "peer review" would take place without filters or censorship.

Figure 8.13. Egyptian vase overlayed with an ellipse.

When it comes to analyzing data, there are no better investigators than cryptographers and mathematicians. Alan Mathison Turing (1912–1954) is one of the most famous cryptographers in history. Turing worked at Bletchley Park during World War II, leading a team that was working on de-encrypting messages from what was known as "The Enigma Machine," which coordinated activities of the Nazi war machine. The results of his and his team's work is credited to have shortened the war and saved millions of lives.

Throughout my research in Egypt, I've always seen my role as a pointer. My books describe artifacts and point to features that I believe should be thoroughly analyzed using the most advanced technology and intelligence available. To the best of my ability I have used rudimentary tools I was familiar with to reinforce my argument. In the case of the predynastic Egyptian vase, this is the first time an Egyptian artifact has been subject to the most advanced methods for data collection, and now the

most intelligent and knowledgeable scientific analysis capabilities have been used to analyze the results.

Mark Qvist, a cryptographer and mathematician, became intrigued by the challenge presented by the vase. He downloaded the STL file after it became available and set to work decoding the information that was collected from the outside surface of the vase. What he revealed is not just remarkable, it is revolutionary. He writes:

> When designing an object, be that functional or purely aesthetic, one can take a multitude of approaches. It is of course possible for the designer to simply place various features of an object intuitively, without any underlying rules, constraints or principles, but practically all great design, art and architecture follow sets of internally consistent principles.
>
> Various systems of design principles have been known since antiquity, and when beauty, completeness and harmony in form is experienced, it is often exactly because of the skillful application of such principles. From the preliminary analysis of the object, we deemed it warranted to investigate whether such a set of principles had been employed in its creation, and if so, to what extent.
>
> An important data point that can be extracted through this approach is the degree to which different design patterns are locked together to form constraints. In design work, such constraints are commonly used to define various aspects of the individual features that make up the finished object.
>
> If we can recreate the object from a relatively simple set of design primitives and constraints, which exhibit low degrees of interrelation, or if indeed no such relations even exist, and all features appear intuitively or randomly placed, this would indicate an object of a relatively low level of design complexity, or one that could have been made entirely from an intuitive process.
>
> Contrarily, if we consistently see features defined by complex interrelations between different principles, this indicates a high level of design complexity, and that a higher level of abstraction was needed; not only in creating the design, but also in transferring it through the production method, to the finished object itself.

The Parametric Model

> To explore what kinds of design principles were used in the creation of the object, we started out by measuring and mapping as many features of the object as possible, and looking for repeating patterns of placement and dimensioning, and repetition of mathematically significant ratios.
>
> While we initially did not understand the underlying principles of what we found, it was clear that patterns and persistent ratios were present in overwhelming abundance throughout the object. Not only were they present, but they exhibited such a high degree of regularity, that we suspected them to be derived from well-defined mathematical formulae.
>
> This led us to attempting something, that really should not have been possible, when dealing with a supposedly ancient artefact, made from granite, of all things: We decided to experimentally build a CAD model that would exclusively use mathematical concepts to dimension and place the features of the object, and use no tuning or arbitrary positional adjustments. All features should be placed and dimensioned by interrelation to each other.
>
> We also limited the initial margin-of-error tolerance of the model to 75 *μm,* in terms of how well it should map to the features of the actual object. This margin-of-error tolerance was, amongst other criteria, used to discern whether an attempted modelling of a particular feature should be considered for inclusion in the model, or rejected.
>
> I find it timely to stress how completely ludicrous this actually is. We are dealing with a stone vessel of supposed ancient origin, and are now proposing, that a purely mathematical CAD model, should somehow map to the actual object within a tolerance of less than 75 thousands of a millimeter.
>
> Yet, I will let the results speak for themselves. Additionally, the CAD model, and all of its constituent equations, are available for verification, for anyone interested in doing so.

As Mark and his associates explored the design principle and underlying geometry and mathematics of the vase, a design familiar to most admirers of Egyptian art began to appear—the Flower of Life.

Figure 8.14. Egyptian vase overlayed with the Flower of Life.

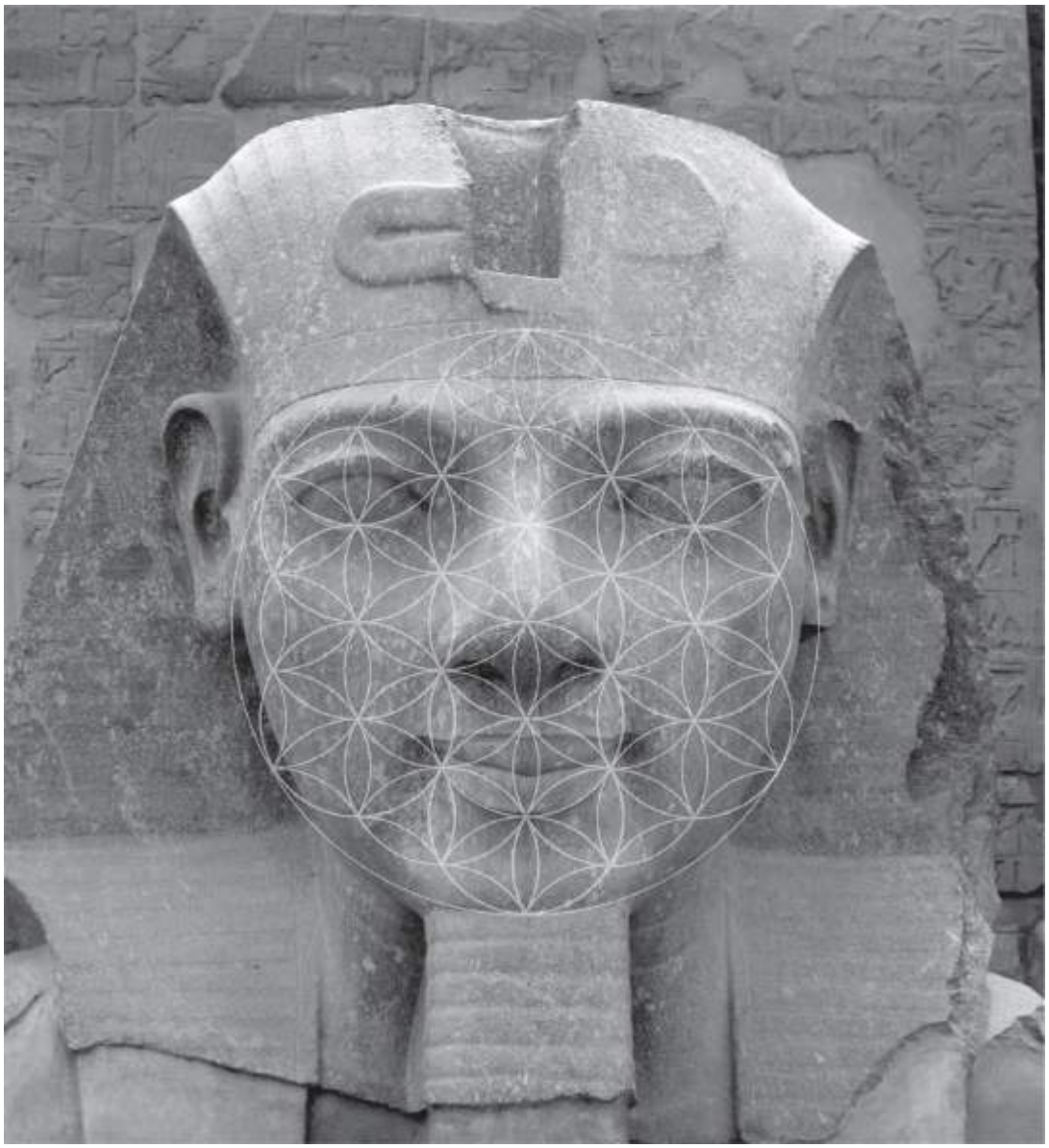

Figure 8.15. The Ramses Statue overlayed with the Flower of Life illustrating correspondences with chin, mouth, nose, and eyes.

Thus appeared the third attribute in the vase that corresponded with other Egyptian artifacts. The design of the face of Ramses, crafted in symmetrical three-dimensional precision, quite elegantly accommodated the geometry of the Flower of Life, as presented in *Lost Technologies of Ancient Egypt*. However, its appearance, I will bet, if seen by a skeptic would cause a reaction akin to a silver crucifix being held up in front of a

vampire. Repulsion. I can almost hear the howls of "New Age Pseudoscience" echoing in the hallowed halls of academia.

When I came to this part of Mark's article, rather than being repulsed, I became curious whether perhaps he knew of me and my work before he wrote his article. In the interest of science, I was hoping that he had not. As it turns out, after receiving a response to my inquiry by email, Mark informed me that he had no knowledge of what I had written before performing his analysis.

With three attributes being shared between the vase and other machined artifacts in Egypt, could I expect or hope for more? It seems like that would be enough, and I should be satisfied. For sure I was more than satisfied, but that didn't mean that there wasn't more. Also existing in Mark's decoding of the vase is the most basic and important revelation of all—the measurement standard that was used to design and manufacture the vase!

Everything we manufacture today is based on a measurement system. Technological advances in laser measurement resulted in a decision to establish base measurement to be the distance light traveled in a second in a vacuum. That would be 299,792,458 metres per second.

Surely the base measurement system used by the manufacturer of the Egyptian vases could not improve on that? Perhaps not, but would we be correct in assuming that they arrived at the same measurement system? Mark Qvist noted in his article: "We do, however, see an interesting *correlation* in this number. The approximation we have arrived at is just a mere 2.07µm (less than the scan accuracy) away from exactly matching the wavelength of an electromagnetic wave, with a frequency of 16 GHz, propagating in vacuum."

In summarizing his analysis of the vase, Mark made some stunning statements which in my previous research and analyses I only implied. That is the prehistoric use of computer aided design and computer aided manufacture (CAD/CAM). He writes, "Could an object like this simply have been a chance happening? A rare coincidence of random alignment? No. Proposing that would be completely magical and superstitious thinking. Maintaining absolute precision and consistency by chance, between all the interlinked systems present in the object, is—simply put—an impossibility."

Addressing the physical requirements to manufacture such an artifact, Mark does not mince his words or equivocate.

> As far as we know, no human beings, trained animals or naturally occurring phenomenae, modern or ancient, take mathematical formulae and equations as input, and produce lathe-operating motions as outputs.
>
> For all of the knowledge and insights we have accumulated over the ages, we know of exactly one, and **only** one *category* of things capable of such behavior: The kind of thing, that we refer to as a *Turing machine*. A device capable of taking input, holding state, performing operations on held states, according to pre-determined principles, and producing output.
>
> They come in many shapes and sizes, and can be constructed mechanically, electronically and even pneumatically or hydraulically. And you are most likely using one right now, to read this article.
>
> *We* call this class of device a *computer*, and no plausible way of representing, operating on, or manufacturing the design of this artefact exists, without having access to one such.

The research on Adam's vase has been a huge step forward in recovering our lost heritage. But it is not finished and much more needs to be done.

And more *has* been done. While a full analysis has not yet been performed, another scan of the Egyptian vases took place on April 12, 2023. This time it, along with three others, were X-ray CT scanned at Zeiss Quality Excellence Center in Wixom, Michigan. Eric Wilson, Adam Young, and I met in Wixom the night before the scan and signed in at Zeiss's impressive state-of-the-art facility the following morning.

This scan was performed because the structured light scan did not produce any data from the inside of the vases, and there was a keen interest in knowing the geometries and precision of the inside compared to that of the outside. The file that was produced by the scan was 80 gigabytes. There has been a cursory examination of the data, but more work needs to be done before releasing any official results. Needless to say, what has been revealed has left us scratching our heads.

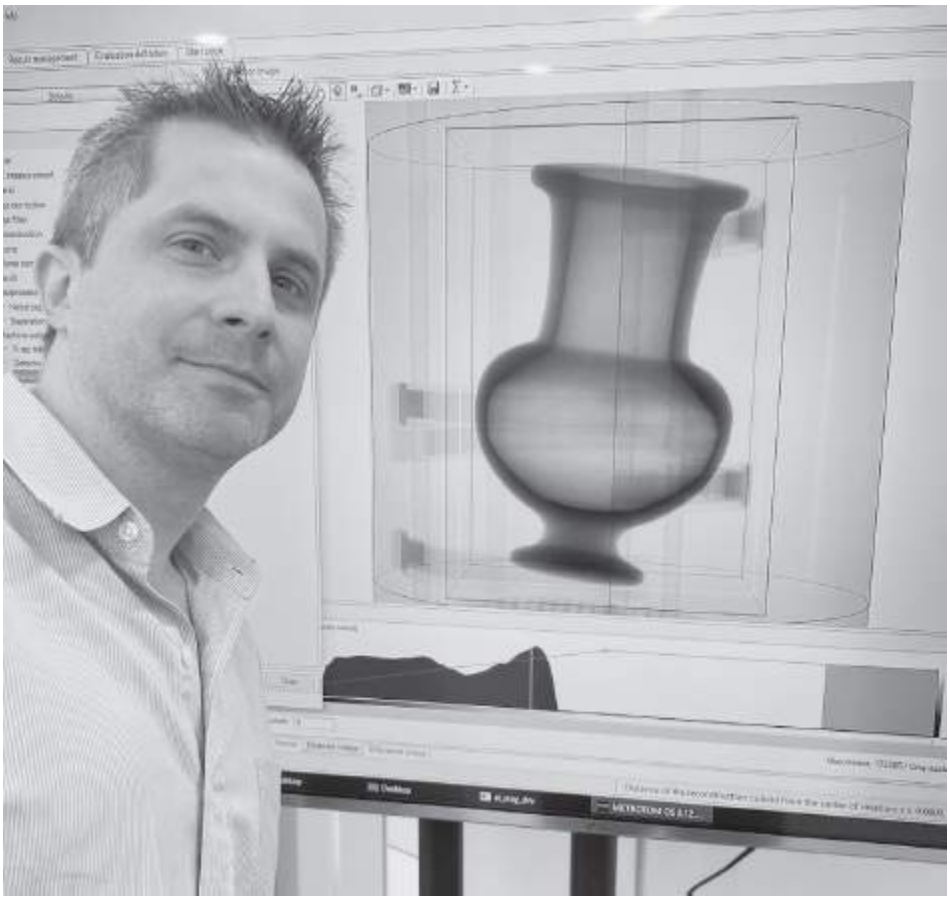

Figure 8.16. Adam Young attending the CT scan of his Egyptian vases.

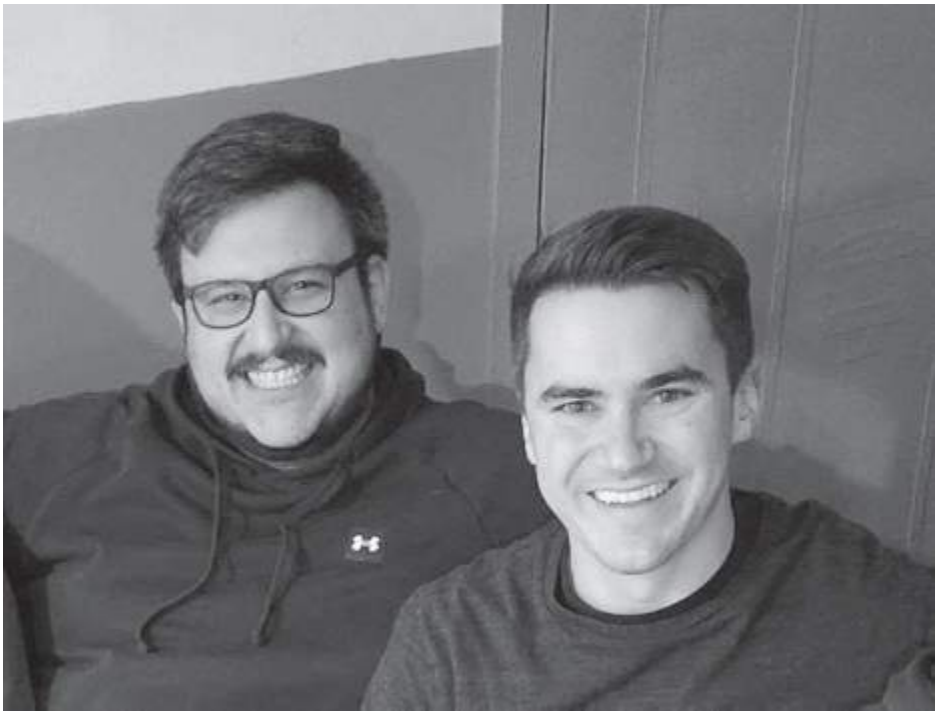

Figure 8.17. Metrologists Nick Sierra and Alex Dunn.

From my perspective, this research program has proven to me that the vase's origins are clearly Egyptian. However, I understand that not everyone may agree with me and another level of investigation will need to take place. But we now have convincing hard data that should encourage the Egyptians to subject similar artifacts with known accepted provenance to examination using similar or more advanced technology and knowledge. Considering how young Egyptians are now accepting this new understanding about their ancestors, I anticipate that in the future they will insist on this taking place.

What will be revealed by a systematic study of a thousand similar artifacts of known provenance? Will we eventually view these caches of vases as time capsules collectively encoded with more of their creator's knowledge? With each individual vase holding a different piece of information that fits within a larger data set?

Considering the period of time in which I have witnessed huge advances in manufacturing technologies, the ten years that have passed since I retired have resulted in so many improvements, it is inspiring. Comparing a modern manufacturing plant with those I worked in 60 years ago, the difference is like night and day. What will the next 60 years look like? With

the evidence presented here of the level of manufacturing that was lost in prehistory, it is not hard to imagine further developments in the future that will result in adherence to similar standards of precision.

When I consider the capabilities that have been observed by Unidentified Aerial Phenomena (UAPs) and ponder on the level of manufacturing excellence that would be required to build these machines, is it too far out on the limb to suggest that micro-machining was taking place in a vacuum and was free of gravitational and magnetic forces? Of course it is! What a ridiculous idea! Nonetheless, I remember a time in my career when a machine of high precision was installed in the plant, and the manufacturer's installation specifications included how the axes of the machine should be aligned to the Earth's magnetic field.

What quality improvements can be made if shafts that have no weight rotate inside bearings that use no oil?

It is a commonly held view that UAPs are the product of a society that has manufacturing capabilities that exceed our own. Speculation about how many years of development it took to achieve their capabilities usually exceed by far the number of years it has taken our civilization to get where we are. The UAPs are teasing us with their capabilities and are finally getting everybody's attention. But they are elusive little buggers, and we cannot hope, with our current technology, to grab one and learn what makes them tick.

Similarly, a pyramid electron harvester would be astronomically expensive to build, but, as we will see in the next chapter, the investment would be quickly paid off and continue to provide value for an untold number of years.

The question, "Where are the machines?" is consequential. The answer to that question right now seems to be beyond imagination. That is, "there are some that are so astonishingly large and others that are so inconceivably small, you wouldn't recognize them."

As Mark concludes in his analysis,

> Only by open, critical and honest scientific inquiry, working from first principles anchored in concrete and verifiable data, can the deepest and most obscured echoes of our shared past be brought into the light of day once more.

> We must allow the observable facts, the givens that we have, to speak without prior interpretation, even if the conclusions risk temporarily upsetting a prior understanding.
>
> In the scientific endeavor, all theories are provisional, and must yield when a simpler one, that better fits the evidence, can be constructed. If this fundamental tenet ceases to hold primacy, science ceases to be science, and instead degrades into dogma (Qvist 2023).

And as Alex Dunn said in his interview with Ben Van Kerwyk, "Data does not have an opinion."

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*Only one vessel is discussed here. It was purchased with the label "Red Amphora Jar" and hereinafter is referred to as "vase" and "object."

NINE

THE ULTIMATE OLD AND NEW GREEN ENERGY MACHINE

Egyptian scientist Gamal Elfouly and I began our studies of the Great Pyramid at around the same time—the late seventies. Without knowing or communicating with each other, we both concluded that the Great Pyramid was a machine, the purpose of which was to supply energy to the civilization that built it. While our models explaining how this was accomplished vary somewhat, our fundamental recognition of reality is the same: The pyramids are machines.

Gamal's assertion on this point could not be stated any better:

> As human beings "The Great Pyramid is a tomb" theory is an insult to our intelligence, especially after finding its precision and workmanship cannot be duplicated today. This means that those who built it were more technologically advanced than us in this regard, and possessed a technology unknown to us that enabled them to do this miracle in stone. That's the reality of the matter whether we like it or not (Elfouly 2012, 35).

BUILDING PYRAMID ELECTRON HARVESTERS

Finance

According to the US Department of Energy, the cost of building a nuclear power plant ranges from $14 billion to $30 billion. For a new fossil fuel power plant, costs are becoming prohibitive. The 582-megawatt Kemper

Power Station, in Kemper County, Mississippi, was designed with carbon capture and sequestration (CCS) technology and was supposed to be the largest coal power station in the United States. Its original cost estimate was $2.4 billion. Construction began in 2010 but in 2017, after costs tripled to an astronomical $7.5 billion, the plans for using coal were scrapped and changed to using a more eco-friendly natural gas. Outside the United States, the cost would be lower, depending on labor costs and environmental regulations.

What would the cost be to build a pyramid solid-state electron harvester the size of the Great Pyramid? Fouad Kamal, who has a background in infrastructure financing for large-scale infrastructure, particularly power plants, emailed me with his estimate of what the costs would be to build the Giza power electron harvester:

> Hi Chris,
>
> I came across your videos whilst researching Egypt and have been astounded to learn of ancient lost high technology, and also viewing the Giza complex as a power plant.
>
> Anyway, the purpose of my message: I have a background in infrastructure financing for large scale infrastructure projects (especially power plants). I tried to estimate the total construction costs (modern day) for the Giza pyramid complex, and apply modern day financial returns analysis.
>
> The objective was to reverse estimate how much Megawatts power (installed capacity) these Giza power plants would have been producing. The results of my analysis were simply incredible.
>
> The numbers suggest it may have been a colossal plant providing energy to millions of people. Or perhaps a mega central power plant providing energy to all sorts of substations (all with those mysterious 70 ton granite boxes with precision shafts) which then passed the power to local areas. Same thing effectively.
>
> A typical, standard coal/gas power plant today will cost a ballpark $1m per megawatts capacity to construct. (Land costs etc excluded). As a ballpark, 1 Megawatt capacity will provide power to around 150–200 homes, as well as industrial/commercial usage, for a location with an above average industrial capacity.

So a medium sized 300MW coal/gas plant in Egypt today would cost around $300m, and provide power to 150,000 urban residents, along with industrial/commercial use. I worked on arranging debt financing a few years ago for a European company to build a gas fired power plant in Egypt fitting these parameters.

So I asked myself, leaving aside our lack of knowledge as to precisely how and when it was done, how much would it cost today to build the Giza complex? And how much energy would such a power plant produce and for how many people?

Quarrying first: You would have to pay for 2.3 million stone blocks (average 3 tons) to be cut, all different sizes/shapes. Let's assume the quarry is publicly owned so the material (granite, sandstone etc) is free.

To cut a granite slab (wholesale) for a kitchen today (2.5m by 1m by 15cm) would cost around $500. It would be ridiculous to assume you could get a 3 ton block cut to unique custom shapes for only $2000 a piece, but let's go with that figure. This covers the cost of labour at the quarry, as well as paying for all the cutting/lifting machines there.

If you mistakenly assume you are paying zero for using the cutting/lifting machines, effectively you are just passing those costs elsewhere, because they themselves would need to be paid for. Let's assume there is a govt quarrying department, and one arm of the govt is paying this quarrying department just for its costs.

So the 2.3m blocks are $5bn for the great pyramid alone. Around $12.5bn when you include the 2 other main pyramids and the smaller ones.

I've assumed the second pyramid is the same size as the great pyramid, and the others all combined (including eg the 3 smaller pyramids next to the great pyramid) add up to another half unit.

Then the transport aspect. Today, SUVs are transported on large trucks that carry 8 vehicles on a double decker structure. The typical cost to transport an SUV in the United States is around $1000. So let's go with a $1000/block transport cost. Even this is very low, because you would need to drive a lot slower with precision stone than with an SUV (which itself has suspension), in order to prevent

cracks. And this is assuming you have a modern world class motorway in megalithic Egypt in place already.

So the great pyramid blocks transportation cost would be around $2.5bn, and around $6bn for all the Giza pyramids.

Now for assembly on site. It would be ridiculous to assume a modern cost of $1000/block for receiving, unloading, sorting, queuing, lifting and placing 2.3m blocks in a precise sequence. There are all sorts of costs excluded here, such as blasting and flattening the bedrock underneath. But going with this figure provides a $6bn assembly cost for the Giza complex.

Note: I have excluded the enormous costs running into hundreds of $millions to architect/design a unique construction of unprecedented size with millions of interlocking blocks, and built to all sorts of mathematical specifications (eg pi/phi ratios, world circumference etc), and all sorts of other specs we don't understand today.

So the ballpark total cost of building the Giza power plant complex would add up to around $25bn. This is $12.5bn for the stones, $6bn for transport, and $6bn for assembly.

And there are all sorts of modern costs (eg insurance) excluded here. I've also assumed these costs are paid in cash, as opposed to getting debt financing from Bank of MegaEgypt and paying interest costs.

With modern metrics, this $25bn would provide around 25,000 MW (25GW) installed capacity. This would provide constant energy to around 10 million people today at Singapore's super high per capita usage. They would have fridges, freezers, TVs, lighting, microwave ovens, computers, washing machines, etc, as well as industrial/commercial usage.

Singapore, a small, densely populated, urbanized and highly industrialized country with extraordinarily intense per capita energy usage, has 12.5GW installed capacity for its approx. 5m population. (Energy Market Authority n.d.)

The entire UK electricity installed capacity is 75GW, with a 67m population. The 25GW installed capacity estimate of the Giza pyramid complex would therefore provide around 33% of the entire UK's power capacity! This equates to electricity supply for over 20

million people in the UK, along with industrial/commercial usage. (Wikipedia 2011)

If the whole Giza complex was a power plant, obviously they wouldn't have gone to such lengths in order to power a couple of kettles. That would make no sense for a rational project.

Viewing the Giza complex power plant from a financial analysis perspective will invariably produce a gigantic MW capacity. You could chop my assumptions in all sorts of directions (eg lowering transport costs) and you would still have an inconceivable number.

Even if you went so far as to chop my assumptions by 99%, this would still be enough energy for over 200,000 people in the UK today at full regular usage.

I would need a broader understanding of the entire pyramid network across Egypt, as well as all those shafts with the granite boxes, to estimate the total energy usage in the country.

However, taking this financial analysis approach is highly relevant and I hope others can start assessing the Pyramid power systems worldwide from this perspective as it will provide new insights.

The basic metrics of financial analysis for energy infrastructure projects are the same for all time. It would apply equally to a windmill in medieval Europe, for example. It would have had a cost to build, and a productivity assumption that would make the cost worthwhile.

I hope this helps.

Yours,

Fouad

Kampower Estimate Metric

(Fouad Kamal, email to author, March 27, 2021, 12:37 pm)

If we take Mr. Kamal's estimated cost of 25 billion dollars for an output of 25 gigawatts of power, providing constant energy to around 10–15 million people a day, a rough estimate can be made of the return on investment (ROI) in order to financially justify building the Pyramid Electron Harvester. I would assume that this estimate would be subject to change as time progressed and lessons were learned, but more importantly, there is much more to learn before a fully accurate analysis can be made. It

would seem, though, that if there was financial and political will behind the research and development of such an endeavor, as there was in the early ’60s when President Kennedy inspired the nation to support the mission to the moon, it could be achieved in a shorter time frame than the 80 years promised for nuclear fusion. Also, as Ashraf El Sherbini pointed out, it would require organizational power with money and connections, using top specialists in all the relevant fields to even arrive at a decision as to whether it was feasible to do it.

Power generation costs vary from country to country and region to region. These costs drive our electricity costs, which also vary significantly depending on where you live. It is not within the scope of this book to provide a detailed analysis of what the ROI would be for each individual power generation source but to provide an overall awareness of the comparison between two methods of achieving the same result. They both start with the extraction of rock from the Earth. The first rock I will discuss is coal.

COAL-FIRED POWER PLANTS

When reading the following, I don’t want the reader to get the impression that I am against coal. How could I be against a material that all my life has kept me warm in the winter, cool in the summer, and fully employed for 52 years? A material that allows me to do what I am doing now—sitting in front of a computer typing this manuscript. Even in Manchester, England, when walking through the smog, which left a black ring on the inside of my shirt collar, I had no hostility toward coal and on a cold night looked forward to getting home and throwing a lump of it on the fire.

I remember waiting in excitement and anticipation for the day I reached the age of eight. This was the day that I was allowed to start the fire that would heat the house and provide it with warmth and hot water. Newspapers, kindling, and coal were carefully arranged on the grate—and I got to play with matches!

No. I love coal for the comfort it has given me. At the same time, I respect and admire our forebears and what they worked tirelessly to accomplish to make life more pleasant for following generations. Without their hard work, none of what we have would be possible. While growing up, I had an uncle who delivered coal to people’s houses. My neighbor

across the street was a coal miner who died of black lung disease. There were reports of mining accidents and horrible deaths, both inside and outside the mines. I learned about the role in the mines of canaries and Davy lamps that would alert miners to get out because of deadly gasses. I also learned about early mining when boys and girls, some as young as six, worked in the mines alongside pit ponies in order to provide for their families. I also learned about waste management when, on October 21, 1966, a slag heap piled on a hillside overlooking Aberfan village in Wales collapsed and took the lives of 116 children and 28 adults.

I didn't work in the mines, so I didn't get the opportunity to see miners at work. However, I did get to admire their spirit and talent when they left the mines: the Welsh miners who, when exiting the mine, raised their voices in song, and their contribution to cultural activities, like the famous Welsh male voice choirs and works bands that competed with their counterparts throughout Britain. Also, I cannot help admiring the resilience of nature as flowers and trees flourished in the slag heaps piled up from mining operations. And miners did not just produce coal and beautiful music. Their children have inspired and entertained millions with their talent. Singers like Tom Jones and Loretta Lynn, the famous actor Richard Burton, and many more. All the while, I still happily and gratefully burnt the coal, either directly or by proxy when paying my electric bill.

However, science and technology evolve, and existing technologies and methods are discarded or phased out after new and better ways of achieving the same results with greater efficiency and less cost are adopted, which brings me back to the discussion about new physics, new science, and new technology for accessing electricity. Just like when burning coal, we don't create electricity; it already exists. There are various methods used for harnessing it, and each method has its own costs and benefits. My intention is not to provide an in-depth analysis of each, as, unlike Fouad Kamal, I am not an expert. In that same vein, the information I have learned about coal, while provided by experts, probably strays from the real truth with respect to accuracy, and I recognize that others with more expertise in the subject might provide more accurate information.

But what I have learned through accessing information available on the subject of coal has raised my awareness about the sheer weight of coal that is mined every day and the primary and ancillary operations needed to mine

it, transport it, deliver it, process it, and feed it into furnaces that burn it to create steam.

Volume of Coal

In 2021, the weight of coal used to create electricity in the US was 461,187,000 metric tons. This is based on a total output of 828 billion kilowatt hours using 1.13 pounds of coal to produce 1 kilowatt hour of electricity (USEIA n.d.).

The Great Pyramid is estimated to weigh around six million tons. Therefore, the weight of the coal extracted to create electricity in one year in the US is enough to create an enormous pyramid 76 times the weight of the Great Pyramid at Giza.

Like many others, when I visit Egypt and stand in front of the Great Pyramid, I am awestruck by its sheer size. A precision, artificial mountain covering thirteen acres that commands attention and has the power to distract visitors from what surrounds it. Now I am awestruck to learn that the coal mined in one year in the United States, if stacked beside the Great Pyramid, would be 76 times its weight and cover almost a thousand acres. Certainly, it would not be cut and stacked with the same precision, but both the coal and the rock that was used for the pyramid came from the same source—our planet, upon which we merely scratch the surface in order to survive. A planet that gives us life and enjoyment while occasionally shaking things up and making adjustments to its topography. Adjustments that sometimes remind us we cannot compete with the Earth in our ability to change its landscape, regardless of how aggressive we become.

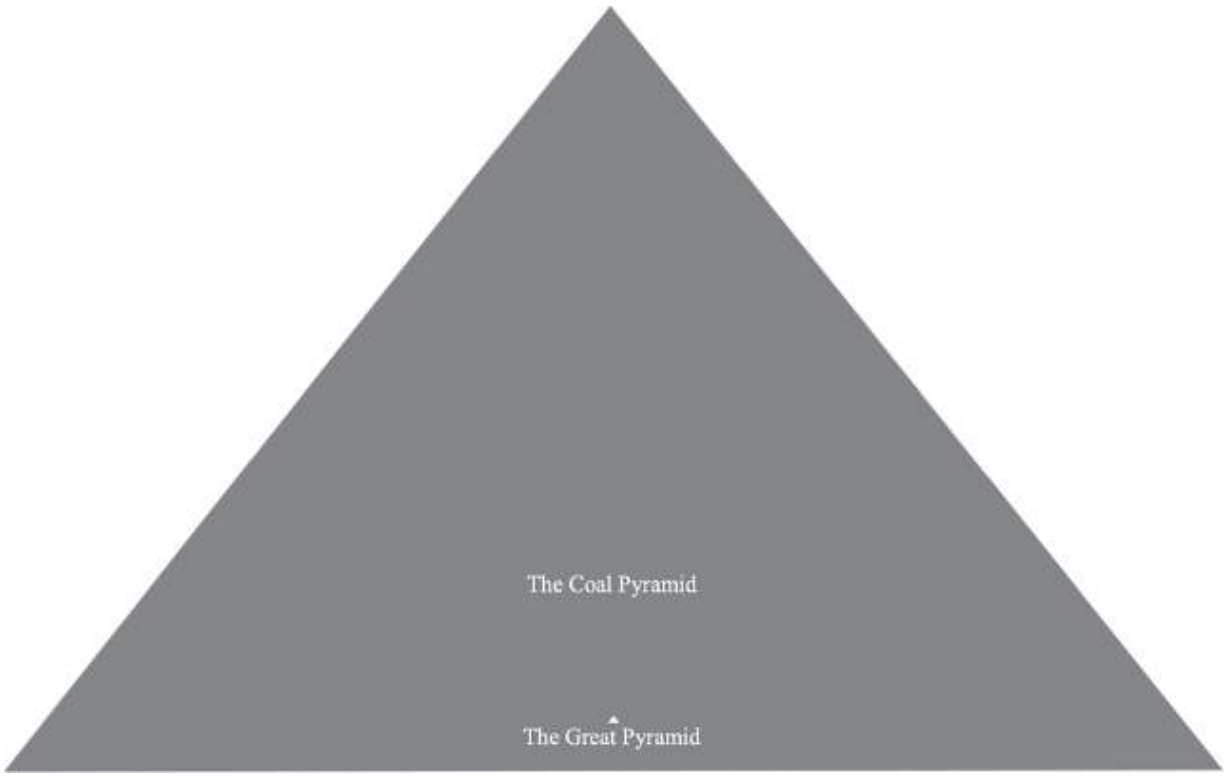

Figure 9.1. The size of the Great Pyramid (shown with small white triangle) compared to the amount of coal extracted in one year to fuel power plants.

The US Energy Information Administration reports that the number of workers employed in the coal mining industry in the US has shrunk from just over 90,000 employees in 2011 to just below 40,000 in 2021. That's a lot of workers who have demonstrated the ability to extract millions of tons of rock. Taking this into consideration, the prospect of building a new Great Pyramid becomes less daunting.

LOCATION OF ELECTRON HARVESTER

Ideally, if we decided to start construction on a new Great Pyramid in the United States, we should learn from the ancient Egyptians and locate it on limestone bedrock where there is sufficient material surrounding it to extract and build the bulk of the structure. Perhaps one location to be studied would be near what has been called the limestone capital of the world: Bedford, Indiana. The quarries around Bedford have provided limestone for many famous buildings, such as the Empire State Building

and the Waldorf Astoria in New York, the Pentagon, and also, most recently, the beautifully crafted Palladium at the Center for the Performing Arts in Carmel, Indiana.

Of interest, in the late 1970s, the town of Bedford received government funding to build a pyramid, with the intention of creating a tourist attraction, and soon had a pyramid under construction near a giant limestone quarry near Needmore, Indiana, about nine miles away. Unfortunately for the project, in 1981, Senator William Proxmire, who had created the Golden Fleece Award with the intention of sniffing out what is known as "pork" spending, got wind of the expense, and the pyramid park became that year's unlucky recipient of the award. The project received no more federal funds, and work on the pyramid ground to a halt (See "Cursed Pyramid Ruins" on the Roadside America website) (Roadside America n.d.).

Figure 9.2. The Palladium in Carmel, Indiana.

It would all depend on the geology of the area, but it's interesting to note that Bedford is located 200 miles from the New Madrid Fault,

Missouri, which is recorded to have produced two major earthquakes that changed the topography of the area: on January 23, 1812, a magnitude 7.0–7.8 earthquake, and on February 7, 1812, a 7.4–8.0 earthquake. New Madrid is located in the Mississippi Valley in an area known as the "bootheel" of Missouri. It lies around 164 miles south of St. Louis. Observations during and after the earthquake were:

- **Sand Boils**: The world's largest sand boil was created by the New Madrid earthquake. It is 1.4 miles long and 136 acres in extent, located in the bootheel of Missouri, about eight miles west of Hayti, Missouri. Locals call it The Beach. Other, much smaller, sand boils are found throughout the area.
- **Seismic Tar Balls**: Tar balls ranging from small pellets up to golf ball size are found in sand boils and fissures. They are petroleum that has been solidified, or petroliferous nodules.
- **Earthquake Lights**: Lights flashed from the ground, caused by quartz crystals being squeezed. The phenomenon is called seismoluminescence.
- **Warm Water**: Water thrown up by an earthquake was lukewarm. It is speculated that the shaking caused the water to heat up and/or quartz light heated the water.
- **Earthquake Smog**: The skies turned dark during the earthquakes, so dark that lighted lamps didn't help. The air smelled bad, and it was hard to breathe. It is speculated that this was smog containing dust particles caused by the eruption of warm water into cold air.
- **Loud Thunder**: Sounds of distant thunder and loud explosions accompanied the earthquakes.
- **Animal Warnings**: People reported strange behavior by animals before the earthquakes. They were nervous and excited. Domestic animals became wild, and wild animals became tame. Snakes came out of the ground from hibernation. Flocks of ducks and geese landed near people (New Madrid n.d.).

BUILDING THE ELECTRON HARVESTER

To get a rough idea of how long it would take just to quarry and deliver to the site the limestone upon which the pyramid electron harvester would be

built, in 1978, author Richard Noone requested a time study from Merle Booker, the technical director of the Indiana Limestone Institute of America, of what it would take to quarry, fabricate, and ship enough limestone to duplicate the Great Pyramid. Perhaps because of the natural and professional appreciation that modern limestone workers have for those who performed the same work in ancient times, Booker performed a detailed analysis and provided Noone with his response as follows:

> Dear Mr. Noone:
>
> As a follow-up to our letter, dated June 26, 1978, we have various Indiana limestone industry members working out realistic quarrying and fabricating time studies for all of the necessary blocks that will be required to duplicate another great pyramid, like the one built in Egypt centuries ago.
>
> Utilizing the entire Indiana limestone industrial facilities as they now stand, and figuring on tripling present average production, it would take approximately 27 years to quarry, fabricate and ship the total requirements. The quantities of various types of blocks were based on a 755’ 9” × 755’ 9” base figure for the pyramid and the side slopes of 51º 51’ 14.3”. Also based on providing a king’s chamber, queen’s chamber, grand gallery, ante-chamber and passageways on the interior.
>
> All exterior and interior blocks were figured on the basis of 12’ 0” × 8’ 0” × 5’ 0” size. Approximately 264,216 rectangular core blocks will be required. Plus 12,723 exterior sloped blocks with very precise joint surfaces. The total quantity of blocks required would equal 131,467,940 cubic feet of quarried finished stone.
>
> Sincerely,
> Merle B. Booker
> Technical Director
> (Noone 1986, 105)

Even after lengthy research and reaching agreement that there would be benefits to building a pyramid electron harvester, the length of time it would take to build one would not be just 10 years or 100 years, as has been suggested by some. If things went well, the time frame to build another

Great Pyramid would be somewhere in between, depending on the size of the quarry, the number of quarry workers, and the size and type of machines that are used. If we look at the accomplishment of one man, Edward Leedskalnin, with proper organization and without unnecessary interference, I would estimate that it would take less time to build it than it took to make the decision to build it.

"I know the secrets of how the pyramids were built!"

While many theorists have made the claim that they *know* how the pyramids were built, I'm not one of them. However, there is one person who left evidence when he died that he had a valid reason for making this claim, because he left standing in Homestead, Florida, an impressive legacy that people flock to daily to marvel at what he accomplished. Evidence of this Latvian immigrant's time on the Earth is not defined by his simple grave marker in Miami Memorial Park Cemetery; Leedskalnin's real monument can be found 30 miles south on Route 1 at a popular tourist attraction now known as Coral Castle. There you will see 1,100 tons of quarried and standing coral bedrock, with some pieces weighing up to 30 tons, providing a testament to the fact that he had a good reason for making his claim. He possessed an extraordinary knowledge that followed him to his grave.

Unfortunately, he did not share his secret and refused to allow people to watch him working. There is a full chapter on Edward Leedskalnin's Coral Castle in *The Giza Power Plant*. However, I believe we don't fully "know" Edward Leedskalnin, and there is still much more to learn. Nonetheless, when it comes to roughly estimating the time and number of workers it would take to build the Great Pyramid, what he accomplished may give us a rough idea.

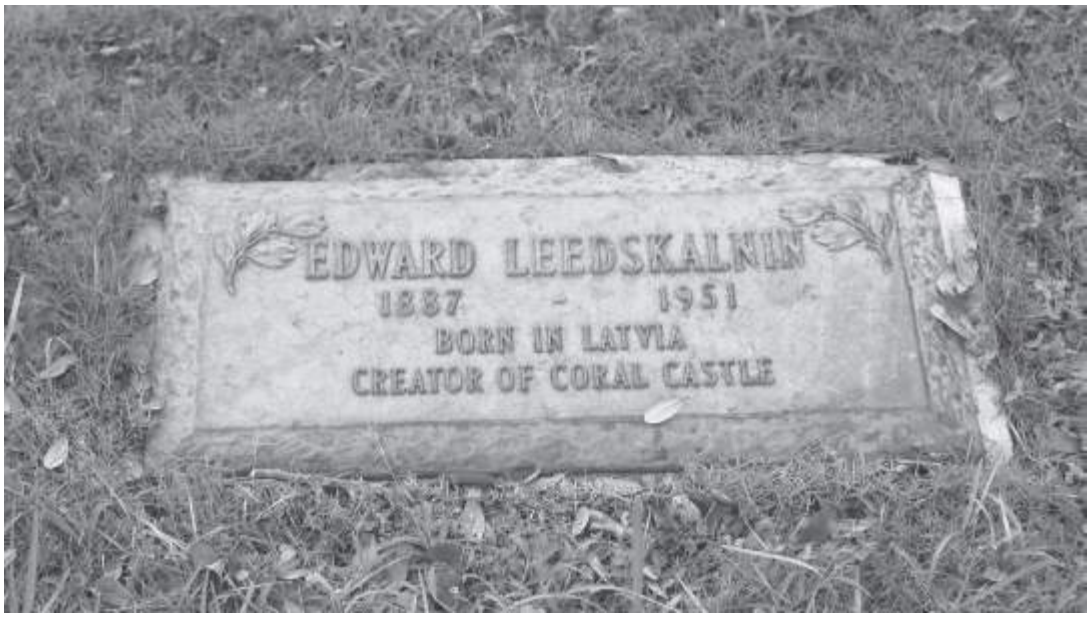

Figure 9.3. Edward Leedskalnin's grave marker in Miami Memorial Park Cemetery.

Figure 9.4. Coral Castle, Leedskalnin's true monument, in Homestead, Florida.

> If we assume that Leedskalnin and the ancient pyramid builders were using similar techniques, we must reevaluate the requirements for the man-hours necessary to construct the Great Pyramid. Estimates provided by Egyptologists for the number of workers that built the Great Pyramid range between 20,000 and 100,000. Based on the abilities of this one man, quarrying and erecting a total of 1,100 tons of rock over a time span of twenty-eight years, the 5,273,834 tons of stone built into the Great Pyramid could have been quarried and put in place by only 4,794 workers. If we figure in the efficiencies to be gained from working in a team and the division of labor, we can reduce the number of workers and/or shorten the time needed to complete the task (Dunn 1998, 112).

When Sir William Flinders Petrie measured the casing stones of the Great Pyramid, he found that the precision of the surfaces were within .010 inch (.254 mm) over 75 inches (1.905 m)—half the thickness of a thumbnail. He made the observation that it was: "Accuracy equal to most modern opticians' straight-edges of such a length" (Petrie 1883, 13). It has been stated that Petrie said the casing stones were finished to optical precision. Considering what he wrote, I suspect he might correct that interpretation. Optical precision generally refers to precise surfaces controlling the behavior of light through reflection or refraction that is dependent on wavelength precision. Petrie was referring to something else entirely.

When I first measured the flatness of the inner surface of the box inside the second largest pyramid on the Giza Plateau (Khafre's), I exclaimed, "Space-age precision." I think it is important to explain what my exclamation was founded on. When I first discovered the precision in Khafre's pyramid, I was shocked. When I said "space-age precision," it was a true statement founded on my background and experience working in aerospace manufacturing. This does not mean that precise flat surfaces were not required in products before we entered the space age. Or that the ancient Egyptians were actively involved with space exploration. What it meant was that if we go back in time and identify a period when precision was necessary on flat surfaces, such as when Johannes Gutenberg developed his flat platen printing press around 1400 AD, his press would not compare to the boxes in the Serapeum or the box in Khafre's pyramid in terms of the

precision required and achieved. I can say that from experience, because I was taught during my apprenticeship in England how to file, lap, and scrape a flat platen to match the precision of a surface plate, which is used in manufacturing to inspect precision components that are used for a wide variety of products.

Possessing practical experience in creating precise flat surfaces, which I didn't achieve by watching a video or reading an internet web page, my reaction to what I had discovered was obviously heavily influenced by comparing what I was seeing in Egypt with my own efforts—which were paltry in comparison. Other engineers and craftspeople can form their own opinions, but of those with whom I have discussed this matter, none have objected to or questioned mine.

My reason for sharing the above information is because it has relevance when discussing the building of a new pyramid electron harvester with the same features as the Great Pyramid in Egypt. The relevant factors are a necessity for achieving accurate geometry and precision where it is necessary and not trying to achieve it where it is not. Both conditions of manufacturing have their own costs, with high precision obviously costing more in terms of machines, time, and skilled workers, who are typically paid more for their labor. Knowing what is required of skilled workers, in *The Giza Power Plant* I discuss the time I visited a quarry worker to learn his perspective.

> Between 1969 and 1984 I lived sixty miles away from Bedford. One day I took an easy and pleasant drive through the picturesque southern Indiana countryside, which was ablaze with fall foliage, to talk to Tom Adams, who at that time worked at one of the quarries. Adams worked in the shop, cutting and dressing the stone, and the accuracy he was required to maintain in his work is not as stringent as for those who work with machine tools. Any craftsperson in a tool shop or machine shop can tell you exactly the tolerances they are working to. I asked Adams about the tolerances they work to in the quarries. He answered, "Pretty close." I asked, "How close is pretty close?" He responded, "Oh, about a quarter of an inch." (6.35 mm) Adams was astounded to hear that the limestone in the Great Pyramid was cut to .010 inch tolerance. His response regarding the abilities of the pyramid builders confirmed my belief that, contrary

> to what we have been taught, the pyramid builders were not primitive workers of stone.
>
> It was clear to me that modern quarrymen and the ancient pyramid builders were not using the same set of guidelines or standards. They were both cutting and dressing stone for the erection of a building, but the ancient Egyptians somehow found it necessary to maintain tolerances that were a mere four percent of modern requirements. Two questions sprang from this revelation. Why did the ancient pyramid builders find it necessary to hold such close tolerances? And how were they able to consistently achieve them? (Dunn 1998, 55–56)

With respect to the requirements and steps to take (except for how the blocks were moved and lifted, the builders of the Great Pyramid left us with guidance on how it was built—the Great Pyramid itself. It has been suggested by some that the Great Pyramid is a "time capsule" that was built with the intention of providing knowledge to future generations. While I might disagree with the idea that it was the sole "intention" of the ancient Egyptians to pass along the knowledge they had gained, structures of all kinds that were built in the ancient past certainly do provide valuable information and give us insights about the people who built them.

The most important part of a building is its foundation. As implied in the philosophy of René Descartes, whether it is the structure you build in your mind or the structure you build physically, if the foundation is not strong and true, neither will be the structure. Regarding the preparation of the foundation upon which the electron harvester will be placed, what we know about the Great Pyramid is that the perimeter of its base was level to within .875 inch (2.22 cm) over 13 acres:

> The level of accuracy in the base of the Great Pyramid is astounding, and is not demanded, or even expected, by building codes which existed in 1974. Civil engineer Roland Dove, of Roland P. Dove & Associates, Martinsville, Indiana, explained that .02 inch (.508 mm) per foot was acceptable in modern building foundations. When I informed him of the minute variation in the foundation of the Great Pyramid, he expressed disbelief and agreed

with me that in this particular phase of construction the builders of the pyramid exhibited a state of the art that would be considered advanced by modern standards.

In *Pyramid Odyssey*, William Fix stated that the most accurate survey of the base of the Great Pyramid showed it as 3023.13 feet (921.45 m) around the perimeter, with the average of the sides being 755.78 feet (230.36 m). If the alignment of this structure was governed by the building standards that existed in 1974, then one side of the Great Pyramid would be allowed a variation of 15.115 inches (38.39 cm) (Dunn 1998, 56–57).

What follows is a rough estimate of what steps may be taken to build the pyramid after a site is selected and approved for construction, the design work is completed, and a contractor is selected to oversee the project. With the project's completion deadline in mind, the main contractor will hire subcontractors working in mission-critical industries who separately and in concert with each other will:

- Estimate the number of workers required to meet the deadline and hire a sufficient number with the necessary qualifications that are needed. Quarries that have high-quality limestone needed for casing stones and interior chambers may decide to expand their operations and install precision machines to cut limestone with greater precision. If not, a separate facility closer to the build site may be built to receive the rough quarried stone and cut it to the specifications provided by the architect. Their machines should also be able to cut granite with precision and ideally will be located near the building site or elsewhere.
- Provide training to quarry workers (like Tom Adams) so that they are able to operate the machines and produce limestone and granite pieces with greater accuracy than what was required of them previously.
- In parallel with the above, contractors will prepare the base upon which the electron harvester will be assembled according to specifications. (Note: Specifications of .020 inch per linear foot accuracy will not be acceptable.)

- Design and build special machinery to accurately bore into the bedrock to create a rectangular passage and subterranean chamber to house pulse-generation equipment.
- Excavate pits in the bedrock near the electron harvester that will house the lower portion of a large saw. See “Under the Shadow of Egyptian Megamachines” (Dunn 2010, 247).
- Build a maintenance facility that will repair and/or replace cutting segments that are affixed to the outside of the saw. Also build administration building, canteen, restrooms etc.

Casing Stone Specifications

To achieve the geometry and precision required in the pyramid—and with an understanding that there is always the risk of an accumulation of error when joining many pieces together—as each layer of the pyramid is built, the casing stones should be the first blocks to be delivered to the site and put in place. They will be surveyed to ensure they are in the exact location they are meant to be according to design specifications, which will include orientation to a precise direction.

For instance, the Great Pyramid is known to be oriented to true north within three minutes of a degree. It is also known that each side of the Great Pyramid has two surfaces, which means that the distance from corners east to west on the north side is greater than the distance from the center of the pyramid on the east side to the center of the pyramid on the west side. (See Figure 9.5.) Therefore, the outer surface of the casing stone must be cut on a compound angle. This means that when viewing a casing stone along its length, with its length defined as the X-axis, its width defined as the Y-axis, and its height defined as the Z-axis, viewing it from north to south on the east side of the pyramid, the pyramid angle of 51º 51' 14.3" is seen on the left side. When viewed vertically from the top, the width of the north side of the casing stone is greater than the width of the south side of the casing stone. (See Figure 9.6.)

State-of-the-art tools that were used by the ancient Egyptians to accomplish this precise construction have not survived the millennia. State-of-the-art tools available today to build a pyramid electron harvester to the same specifications found in the Great Pyramid are powerful and efficient and when applied can provide quality control and assurance that the design specifications are met or exceeded.

For data acquisition and analysis, each casing stone and interior wall, floor, and ceiling block can be scanned by a laser, and the information gathered can be imported into a computer where it is placed within a model. Existing will be an efficient orchestrated, real-time, and continuous transfer of data between the architects, the building site inspectors, the data analysts, and the mill that will receive instructions if changes are needed to any parameters to machine the blocks.

The dimensions of the X- and Y-axis of the casing stones may vary depending on the size of block that is delivered by the quarry to the mill, but the casing stone that defines the center of the distance of one side must be cut to assure that the surface that touches the next block face (defined by the Y-axis and Z-axis) is dead center. Think of it as a giant Tetris puzzle, where players can make changes to blocks that are not quite the right size. Also, imagine the number of men and women around the world who have the qualifications to play this game. They could work from home, download the scanned data from a block as it leaves the mill, place it within their computer model, and, if it fits virtually, authorize its installation. After the block is installed, they can then download the data acquired from the build site to verify its correct position. This process can be repeated for every casing stone that is installed.

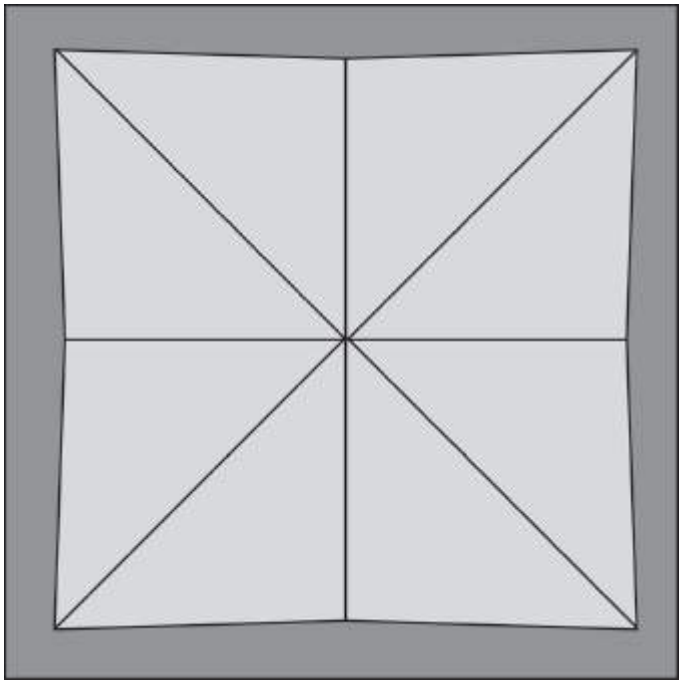

Figure 9.5. Top view of Great Pyramid.

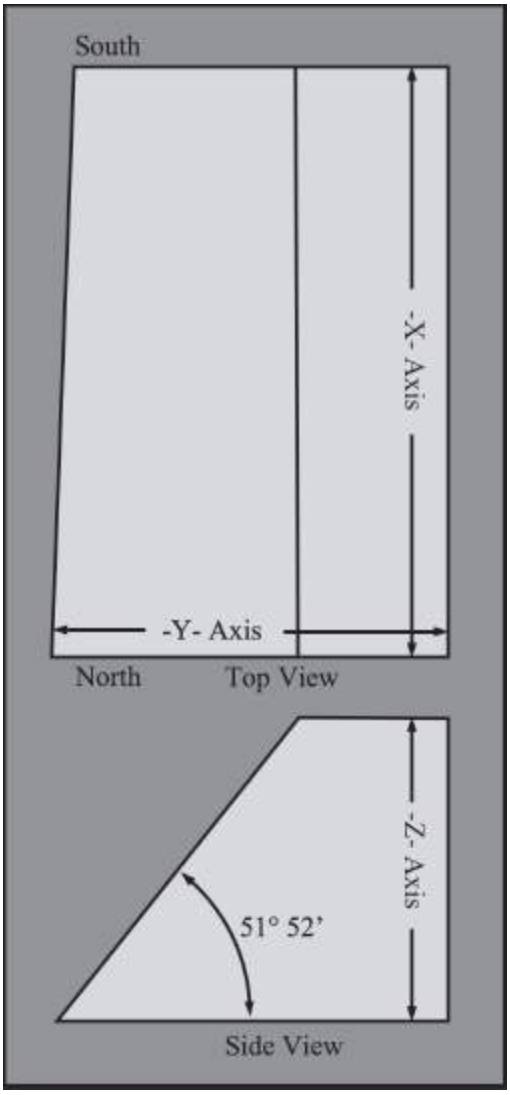

Figure 9.6. Geometry of a casing stone.

Sequence for Assembling Blocks

1. Assign and affix a tracking serial number on every block that leaves the quarry before finish work is performed on them.
2. Upload serial numbers and dimensions of the block to a central database.
3. Install casing stones and, as the pyramid rises virtually and physically, install precision blocks required to build its chambers, passages, and shafts.

4. Install core masonry blocks. They can be of varying shapes and sizes that are cut efficiently on site using the giant saws. The tops of core masonry blocks positioned next to a casing stone will need to be cut on the same plane as the casing stones to provide a surface to accurately position another layer of casing stones. Perhaps, also, they should be made from a higher quality of limestone than those that do not have a casing stone on top of them. The same considerations would apply to the core masonry blocks touching and supporting the precise blocks that create the interior architecture.

Core masonry blocks that are installed between the outside casing stone blocks and interior architecture can be any size and shape; their purpose is to fill in a large volume of space. For instance, when I visited Egypt for the first time in 1986, a helpful man whom I ran across near the so-called Queen's Pyramids located south of the third pyramid (Kephren's) showed me an opening in the south side of the pyramid. At his insistence we crawled into it, and I found myself in a large space looking up at a massive core masonry block. Not knowing the full size of the block, what I could see on this block's underside exceeded by far the dimensions of the core masonry blocks that can be seen outside the Great Pyramid.

From Egypt to Lebanon, Turkey, and many other places around the world, our ancient ancestors demonstrated that it was routine to cut, transport, and erect massive blocks of stone, some weighing more than 1,000 tons. Aside from the structural strength obtained by using such large-sized blocks of stone, from an economic and efficiency perspective, the greater the volume contained in a single block to fill in a space the better, for the cost of cutting into smaller blocks is avoided.

Production Considerations

The volume of stone that makes up the core masonry greatly exceeds the volume that comprises the casing stones and interior architecture. If the percentage of precision-cut stone is, say, 20% of the total amount of stone, then core blocks that are five times the volume of precision-cut stone must be quarried, delivered, cut on site, and positioned so that, ideally, all layers of the pyramid rise at the same time. However, a reasonable amount of time between the first stone being laid and the last one may be tolerated. Also, the personnel on site can decide what size block is added to the core

masonry. For this work, the parameters they are required to work within have already been established by the existing precision-cut stone that was tightly controlled by architects and metrologists.

Building the Tesla Dome

Positive electron holes that are squeezed out of the igneous rock and flow upward to and through the electron harvester will combine with negative electrons in the Tesla dome, where it will radiate out in the same manner as Tesla imagined, except unlike Wardenclyffe Tower, which received power from a conventional power plant and distributed it wirelessly, the pyramid electron harvester dome is receiving electrons directly beneath its location on the earth's surface. As Friedemann Freund's research showed, this process is initiated when the igneous rock is subject to pressure. Even after the pressure is released, the positive holes continue to flow. To measure this, Freund created a circuit between the end of the granite being put under pressure and connected it with a wire to a copper cap at the other end.

It may be argued that no evidence exists to indicate a dome once covered the Great Pyramid, or any other pyramid for that matter. It's true. There is nothing to see in the archaeological record or in any hieroglyph or relief that I'm aware of that shows a pyramid covered by a dome. Nonetheless, if we were to build a dome over the Great Pyramid in Egypt, Petrie identified four sockets near each corner that we might use as anchor points:

> Since the time of the first discovery of some of the sockets in 1801, it has always been supposed that they define the original extent of the pyramid, and various observers have measured from corner to corner up them, and thereby obtained a dimension which was—without further inquiry—put down as the length of the base of the pyramid. But, in as much as the sockets are on different levels, it was assumed that the faces of the stone placed in them rose up vertically from the edge of the bottom, until they reached the pavement (whatever level that may be) from which the sloping face started upwards. Hence it was concluded that the distance of the socket corners was equal to the length of the pyramid sides upon the pavement.

> On obtaining accurate measures, however, of the relations of the sockets to the casing on each side, it was found that the sockets lay two or three feet outside the line of the casing of the pyramid on the pavement; and also that the mean planes of the core masonry of the Pyramid were far more nearly a true square than the square of the sockets. The socket distances varying on an average 4.4 inches from the mean and the core size varying but 1.0 inch from their mean length; while there was also a similar superiority in the squareness of the core. This first threw doubt on the sockets representing the original base; and on comparing that distance from the center of the pyramid. It was seen that the deeper the level of the socket the further out it is from the center (Petrie 1883, 10).

If it is decided that a dome would add value and functionality to power distribution, it can be designed to provide multiple connection points on each face of the pyramid and also the top. While the material the dome is made of and its design are yet to be determined, when considering how it is constructed and how quickly, there are several build plans that could be considered. See color plate 6.

Ideally, the dome will grow at the same time the pyramid is being built, and the dome will reach the top not long after the pyramid capstone is put in place and will be connected to it. Using technology that is available at this time, there are several ways of achieving this.

- Use traditional fabrication out of foundry/mill metal. Sections are shipped to the site and assembled.
- Use 3-D printer robots to create the dome on site as a monolithic structure that does not have joints.
- Print interlocking modules that will be brought to the site and assembled. (Dare we even imagine that nanomachine universal assemblers may have a hand in this?)

Figure 9.7. Pyramid with Tesla dome

I wouldn't even dare to imagine the advances in construction technology and capabilities we will have in 20, 30, or 50 years. Nor did I imagine 25 years ago the advances in construction that today incorporate functional capacity with elegant and beautiful design, such as the Museum of the Future in Dubai. I would anticipate that when it is time to build the pyramid electron harvester, considering the advances made in 3-D printing in the last 10 years, its application will reflect all knowledge, imagination, and skill in a dazzling display of beauty that will shock and inspire the world.

Operating Costs

Considering that the electron harvester would be located directly above the energy source, its operating costs would be miniscule compared to the operating costs for a conventional power plant. After it is built, no more material, other than chemicals, needs to be extracted from the Earth. It won't need to burn coal, oil, or gas or use nuclear material to generate electricity. However, it's impossible to calculate accurately what the energy output and associated operating costs will be at this time. Amortized over a

fraction of the life of the harvester, I predict that the ROI will be relatively short. Six million tons of precisely cut rock delivered, assembled, and functioning in such a way as to squeeze electrons out of the Earth would run for years, maybe decades, with little interruption. Materials for continued operation, such as chemicals for the Queen's Chamber shafts and perhaps oil for maintaining the pulse-generation equipment in the Subterranean Chamber would need to be sourced and delivered. Then there would be site maintenance and administrative costs, but that's about it.

Environmental Impact

The environmental impact of the pyramid electron harvesters will be transformative, not just in how the biosphere will be improved but also in the effects that it will have on how humans and animals respond to an environment that exists in harmony with the Earth and the universe. Acoustically and visually, our environment has changed since the dawn of the industrial revolution. We have learned to live with discordant noise and bad smells. Developing machines and systems that are in harmony with the universe's natural frequencies can benefit all of earth's living creatures.

Maintenance Costs

The electron harvester will require occasional maintenance. This is indicated by the evidence discovered at the upper end of the Queen's Chamber shafts. It is clear that the South Shaft electrodes would need to be changed occasionally; the question is, how is that area accessed to change them? I had previously discussed the possible existence of access tunnels being included in the design of the pyramid, similar to the winding tunnel proposed by Houdin, and that may be the case. However, the question Hany Helal asked me at the close of our meeting in September 2021 was one of those important questions that, like Tompkins's question that I discussed at the beginning of the book, opened my mind to what I had previously considered inconceivable and was a question from which this chapter grew in scope and detail.

RESTORING THE GREAT PYRAMID IN EGYPT

When my meeting with Hany Helal and Hamada Anwar was drawing to a close, Helal asked me if the Great Pyramid could be restored to operational

status. I had thought about this question before but not very deeply, as I never thought that a senior member of the Egyptian government would even ask that question. Moreover, it was my personal opinion before this meeting that the Egyptian people would not support such an endeavor. Another factor was that calculating the costs and time to complete a full restoration is beyond my ability. It's complicated and I've had a lot of time to ponder that question since it was asked, but after Helal asked it and I had become aware that attitudes were changing not only among the population in Egypt but in the highest level of Egyptian government, the question deserved a more serious study.

That this section is the last one in this chapter is not an indication of its level of importance. In fact, it is the singular question that inspired this chapter to be written. It is only last because of the sequence of engineering steps—design, build, operate, and maintain. In many ways, it is probably the most important section of the chapter.

As I was writing this chapter, in the back of my mind was the thought that some readers are probably asking, "How are the blocks that are being placed in the pyramid electron harvester going to be transported and lifted into place?" I believe I know the answer to that question. Just like the questions asked as more information has been provided on the Great Pyramid over many years, it relies on reverse engineering, but it is also different because, with the Great Pyramid we have been able to study it closely inside and out and have amassed an enormous amount of data, but we have not yet seen it operate.

With the recent disclosure of UAPs and the acceptance of the fact that machines are navigating within our airspace and exhibiting extraordinary gravity-defeating capability, we are witnessing a machine's operation but we have not been able to gather any data that explains the technology employed to accomplish it. Understanding the technology that allows these machines to perform as they do and using that knowledge to develop systems and techniques for eliminating the effects of gravity when lifting and moving massive blocks of stone is imperative both to the building of another Great Pyramid and repairing one—including the original in Egypt. No, I'm not suggesting that we cause a UAP to crash (even if we were able to) in order to have access to it. However, I think understanding how Edward Leedskalnin built Coral Castle would be time and money well spent. The most important lesson in all this is gaining an awareness that

antigravity has been achieved in the past, is being demonstrated today, and can be achieved in the future.

To bring the Great Pyramid in Egypt back to operational status would require us to access its broken and damaged features and repair or replace them with the same care and precision as when it was originally built. For maintenance, repair, and restoration purposes, the ancient Egyptians would have been as capable and efficient in using their technology to take the Great Pyramid apart as they were when they put it together. In the event that the electrodes needed to be replaced at the end of the Queen's Chamber South Shaft, a long, winding tunnel within the mass of the Great Pyramid would not be feasible if just the removal of a few blocks on the south face would give us access to a short tunnel. With respect to antigravity, to my knowledge, we are not quite there yet. I don't expect we will get there in my lifetime, but I believe present and/or future generations will.

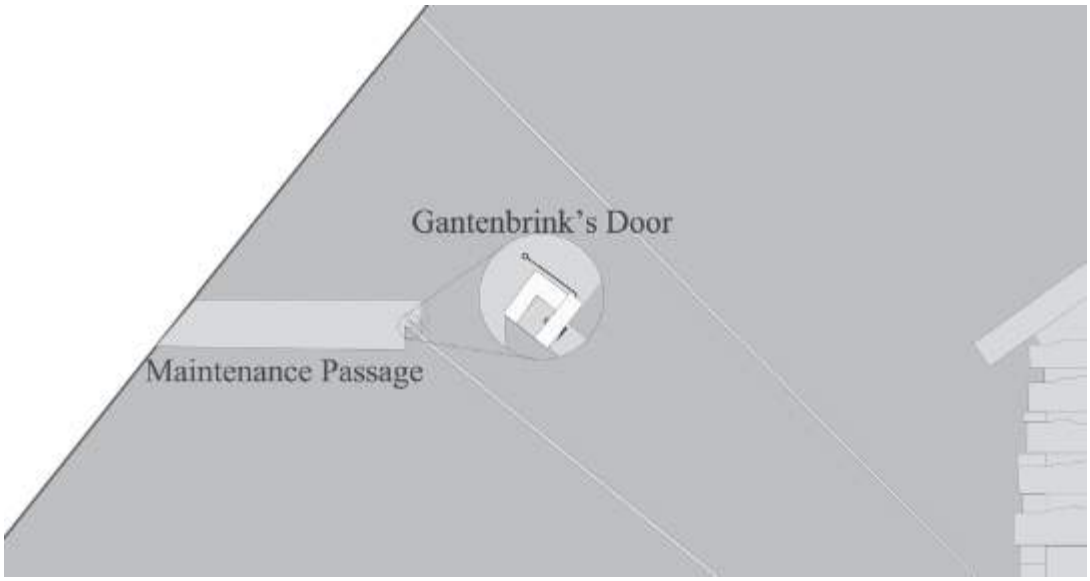

Figure 9.8. Maintenance passage to replace electrodes.

While the reasons for the angles of the Queen's Chamber South and North shafts have generally been interpreted to be symbolic—with their relationship to particular stars being an appealing and popular idea—I would like to propose a more practical reason for these angles. Two requirements were achieved when these shafts were oriented in this way.

1. Maintain a head pressure to provide chemicals to the Queen's Chamber in a specific amount over a period of time.
2. Position the end of the shaft at a point where it is close to the outside of the pyramid and more easily accessible for maintenance.

By having a vertical shaft, we can achieve one requirement but not both. By having a horizontal shaft of the same length, we cannot achieve either requirement.

In *The Giza Power Plant*, I addressed the question of how great civilizations come to a violent end. In 1998, both the US and Russia possessed significant nuclear arsenals, but there was relative peace, which made us more comfortable in the continuation of this status quo. Considering the current unrest in the world, it seems appropriate to end this book the same way I ended my first book, though when I started writing this book in 2021, I believed it was an external force, such as asteroids, meteorites, or coronal mass ejections that caused cataclysmic events that wiped out prehistoric civilization, and wasn't thinking about nuclear:

> One of the most inconceivable events with which modern humans are faced is nuclear disaster. Though the threat of all-out nuclear war between the United States and the former Soviet Union has been greatly reduced, it is still possible that our civilization could be wiped from the face of the Earth by a few miscalculations in foreign policy, a reckless terrorist act, or an error or malfunction in our own nuclear weapons or devices—the ones supposedly protecting us from a premature reaction to a nonexistent threat. Could it happen? Most of us believe that we, as a species, are simply too smart for these possibilities to overtake us.
>
> Has it happened before? Were the ancient Egyptians smart enough to ensure that their own civilization would endure? The greatest lessons regarding our own mortality may begin with the pyramids of Egypt, the strong evidence of advanced machining practiced by the ancient Egyptians, the geological and biological records, and the world's ancient sacred records. These are all pieces of a giant puzzle that so many of us are trying to piece together. I have hope that we will regain this lost knowledge and learn from the

lessons of the far distant past in time to save our own society from the fate that likely befell advanced civilizations that came before us. And I hope that along with granting us the wisdom to survive, this knowledge also may provide us the means through which we can evolve–spiritually, intellectually, and technologically—into more than we have ever chanced to dream (Dunn 1998, 256).

APPENDIX A

A BRIEF EXPLORATION INTO THE ACOUSTICS OF THE GREAT PYRAMID

ROBERT VAWTER

INTRODUCTION

Much has been written on the sound (acoustics) within the Great Pyramid. Unfortunately, there have been no thorough systematic measurements of the pyramid to substantiate the claims made by most of those authors. This article summarizes a few of the better researched attempts to examine the acoustics of the pyramid and presents my own research over the last 25 years.

Other UNESCO sites, such as the Hagia Sophia and the Taj Mahal, have been examined by acoustics experts. In the case of the Hagia Sophia, Stanford University's Center for Computer Research in Music and Acoustics (CCRMA) developed a computer simulation and processing program to emulate the acoustics. While the measurements conducted by Thomas Danley are deservedly cited often, his data is limited to the King's Chamber. Unfortunately, Danley published precious little specific frequency information (Danley 2000). No systematic study of the entire pyramid's acoustic environment using modern techniques, such as Fast Fourier Transform (FFT) analysis of sine wave sweeps, has been done as of the time of this writing.

NOTES FROM THE RED PYRAMID AT DAHSHUR

Back in 1996, I was part of an experiment in the Red Pyramid at Dahshur, along with Abd'el Hakim Awyan and Stephen Mehler. It was a very rough technique using chanting as the sound source and measuring the resonant frequencies when we found them. I used a Korg professional tuner certified to be accurate to 1 cent, which is $^{1}/_{100}$th of the difference between two notes in the modern equally tempered scale.

While in the pyramid, we measured 26 resonant frequencies. Later that evening, I noticed only six different frequencies had actually been measured. Five "notes," or octaves of them, had been measured several times at different places, and one frequency had measured only the upper chamber. At the time, there was a large excavation in the floor that has since been covered up. I subsequently decided to discard that single outlier frequency as not being part of the original design specifications. The dominant frequency seemed to be an F# plus 18 to 23 cents, as we had several solid readings in that very narrow range. This "note" is slightly less than a quarter of the way between a modern F# and the modern G. When I returned home, I connected with a friend who had a small harp, and we tuned the harp to the five main frequencies measured in the pyramid, omitting the outlier from the room with the large excavation in the floor.

To our surprise, the five notes were harmonically related and formed a musical scale. It was not a scale in the modern equally tempered sense—in other words, the frequencies did not align with the modern notes A, B, C, etc. Yet when played it was very pleasant sounding. This observation is analogous to examples of other ways to construct musical scales today, such as the variety of scales found in Japan, India, the Middle East, Native American flutes, and modern microtonal compositions. This experiment led to three fundamental realizations.

1. There is no good reason to assume the ancients used modern musical sensibilities. This view is supported by looking at research into the Ney flutes by Professor Mahmoud Effat, Professor Fathi Saleh, and Professor Robert Gribbs. Their research found microtonal relationships as well as a diatonic scale in the replicas of the ancient flutes they tested. Additionally, changes in the tunings of

the flutes illustrated the evolution of music during dynastic times (Effat 2000).

2. Resonant frequencies typically are emphasized by the presence of parallel surfaces and the formation of standing (resonant) waves bouncing back and forth between those surfaces. In acoustics, these are known as modes or eigenvectors. The frequency in these cases is determined by the distance between the walls. In short, the dimensions of the rooms and the distance between the corbels in the Red Pyramid determined the resonant frequencies we measured. Since those frequencies did not correlate to the modern equally tempered scale, it was necessary to deal with the acoustics in terms of frequency only, and we were not able to draw parallels to modern Western music.
3. The realization that we were looking at a musical scale led to a rather unexpected conclusion. To construct a building the size and complexity of the Red Pyramid and to have the resonant characteristics precise enough to create melodic relationships between the individual notes could not have been accidental; it must have been intentional. In other words, the ancient Egyptians knew what they were doing.

THE GREAT PYRAMID

Any discussion of resonant frequencies must include the dimensions of the rooms, corridors, corbels, etc. These are the primary determining factors for resonance. In the case of the pyramid, the hard rock surfaces emphasize this point. While modern laser scans have been done, the data is unfortunately not publicly available. The estimates cited in this paper primarily use the measurements provided by Sir William Flinders Petrie: “Probably the base of the (King’s) chamber was the part most carefully adjusted and set out; and hence the original value of the cubit used can be most accurately recovered from that part. The four sides there yield a mean value of 20.632 ± .004, and this is certainly the best determination of the cubit* that we can hope for from the Great Pyramid” (Petrie 1883, 28).

This measurement, and multiples of it, repeat throughout the Great Pyramid, and will be referred to often in this paper. For example, the Petrie cubit x 10 equals the width of the King’s Chamber and is exactly half of the

length of that chamber. This measurement is also found in the Queen's Chamber and in the spacing of the Girdle Stones found in the Ascending Corridor.

The repetitive nature of certain frequencies throughout the pyramid leads to another observation.

In my experience setting up and operating large sound systems for concerts and theatre, it was necessary to identify resonant characteristics in rooms and take steps to control or remove them before problems such as feedback occurred. This could ruin a performance. There are also related issues regarding reverberation, intelligibility, and psycho-acoustics that affect a complete description of an acoustic environment. However, the pyramid seems to be designed to do the exact opposite—deliberately repeating and emphasizing certain frequencies throughout the entire structure. In other words, it is creating a very specific acoustic environment, which amplifies certain frequencies in multiple aspects of the design. The interaction of these waveforms is known as nonlinear acoustics.

Only certain parts of the pyramid's internal structure will be discussed here, as the existence of the blocks in the lower part of the Ascending Corridor would have isolated the Descending Corridor down to the Subterranean Chamber from the rest of the system. Similarly, the Queen's Chamber Corridor and the Queen's Chamber itself will only be mentioned briefly, as there is evidence that they were also isolated from the Grand Gallery (Maragioglio and Rinaldi 1965). These limitations also focus the discussion on the system Chris Dunn is describing in his book (Dunn 1998).

THE ASCENDING CORRIDOR

To determine approximate resonance characteristics of the Ascending Corridor in the pyramid, I have modeled it as a long, rectangular organ pipe. These equations are well established, and additional phenomena, such as end correction, can be included. It is also possible that bell tones may be generated, since there is a slight tapering in the corridor as one moves down toward the granite blocks, which could also be interpreted as a slight flare as the corridor opens up into the Grand Gallery. Additionally, the existence of the blocks in the lower section determined the corridor should be treated as a closed organ pipe. This significantly changes the harmonic content of the resulting sound.

It is difficult to estimate the exact length from the end of the blocks to the top of Ascending Corridor. Petrie concluded that the end of the present top block is not in the original position: “The granite plugs are kept back from slipping down by the narrowing of the lower end of the passage. . . . The present top one is not the original end; it is roughly broken, and there is a bit of granite still cemented to the floor some way farther South of it. . . . From appearances there I estimated that originally the plug was 24 inches beyond its present end” (Petrie 1883, 21).

Taking the overall length, and allowing for Petrie’s observation, gives an approximate length of 107.8 feet (32.86 meters) from the end of the blocks as originally placed to where the corridor opens into the Grand Gallery. These dimensions yield an estimate of 2.6 Hz for the fundamental frequency and 7.8 Hz for the third harmonic for an organ pipe of this size. This is well below the threshold for human hearing. Chris Dunn has theorized that the pyramid is acoustically coupled to Earth’s natural vibrations (Dunn 1998, 138, 219). While the estimates for the Ascending Corridor frequencies are higher than the extremely low frequencies (ELF) discussed in the ocean-caused scientific literature on earth hum, this frequency range is consistent with seismic activity.

A paper published by the United States Geological Survey on earthquakes and geologic hazards states the following: “When a fault ruptures, seismic waves are propagated in all directions, causing the ground to vibrate at frequencies ranging from about 0.1 to 30 Hertz. Buildings vibrate as a consequence of the ground shaking. . . . Compressional waves and shear waves mainly cause high-frequency (greater than 1 Hertz) vibrations which are more efficient than low-frequency waves in causing low buildings to vibrate” (Hays 1981).

The Descending Corridor is long enough to get into the ELF ranges. At about 345 feet (105.156 m) long, an organ pipe of that size could be expected to produce a fundamental frequency of about 0.82 Hz. Since infrasound travels though buildings and solid rock, the pyramid could be reacting to these frequencies. Only specialized equipment such as geophones would let one know if that is the case here.

I believe this supports Chris Dunn’s theory that the pyramid may have been acoustically coupled to Earth frequencies by employing the physical properties of tuned resonance. This line of thinking deserves continued investigation.

THE GIRDLE STONES IN THE ASCENDING CORRIDOR

One problematic detail in the pyramid design deserves mention here. Standard pyramid theory states the so-called Relieving Chambers (A) function as a stress-relieving feature to mitigate the weight from the blocks above the chamber and prevent the King's Chamber roof from collapsing. If this is the case, then why is there no analogous feature over the Queen's Chamber (B)? It is lower in the pyramid and closer to the centerline, so there is significantly more weight pressing on it. The angled roof is sufficient there, so why was it deemed necessary over the King's Chamber?

A similar situation can be seen in the Ascending Corridor. The presence of the three Girdle Stones near the center of the corridor (D) is also classified as a stress-relieving feature designed to prevent the passageway from collapsing. However, the weight above the corridor is greater in the section (C) farther up the passage from the location of the Girdle Stones. This is due to the outer slope of the Pyramid rising at a rate approximately double the slope of the Ascending Corridor floor. If the Girdle Stones were not needed for structural reasons, could there be another explanation?

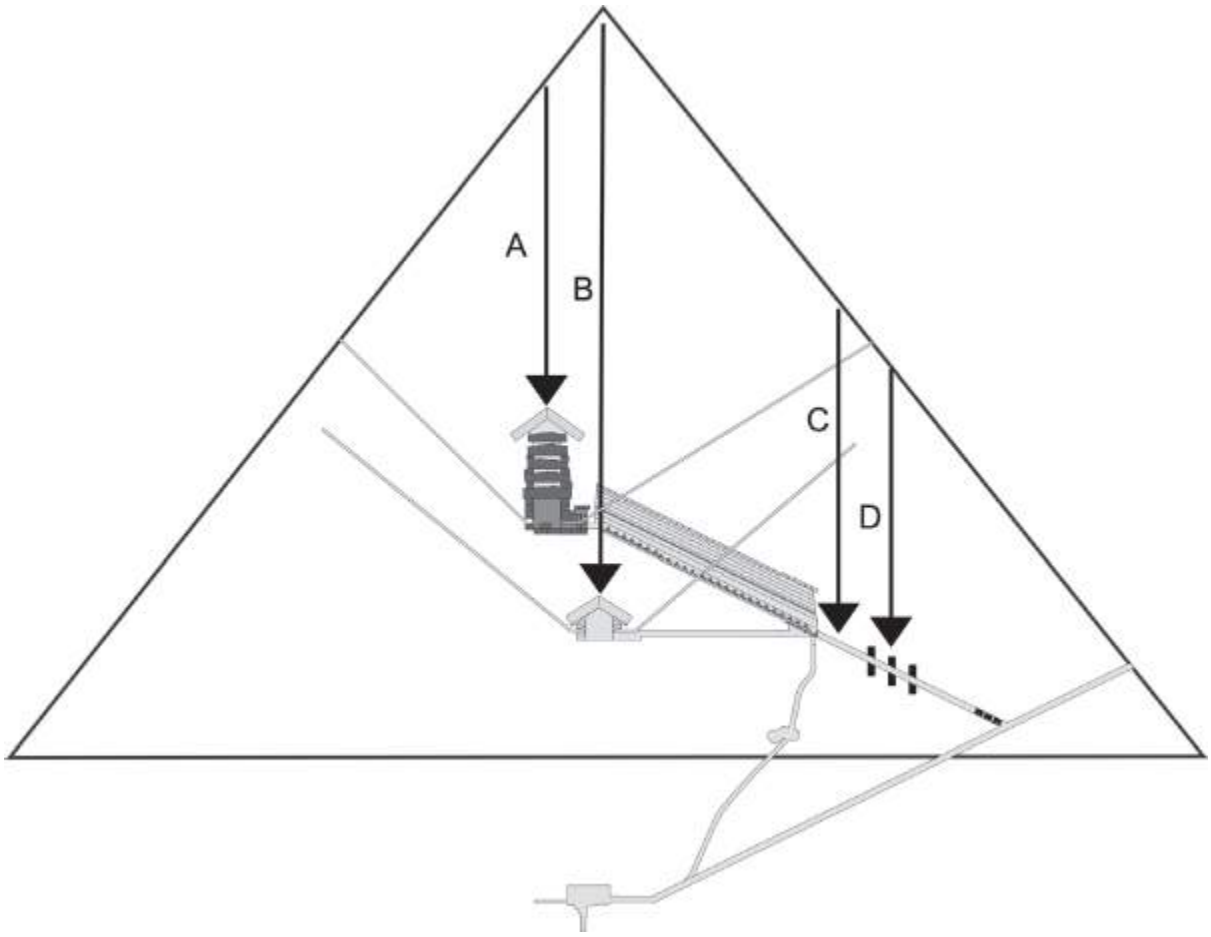

Figure Aa.1. Weight distribution locations discussed in this section.
Appendix A images credit: Robert Vawter unless otherwise noted.

The Girdle Stones are equally spaced "on center" like studs in a wall. This is the same measurement found in the King's Chamber width (206.32 inches [5.24 m]), and equal to half of the King's Chamber length. This measurement also appears in the Queen's Chamber and is directly related to other dimensions found in the Grand Gallery.

In short, my acoustic analysis is to view the "corridor" as an infrasonic, closed-end organ pipe rather than classify its function as a corridor or passageway. To see this analogy in more detail, it is necessary to look at the precise measurements of several features in the Ascending Corridor. William Kingsland compared Petrie's measurements and those made by Morton Edgar (Kingsland 1996). Kingsland also draws attention to the deviations in the masonry layout in the corridor. His detailed drawings

show some specific seams are a true vertical, while others are angled perpendicular to the slope of the floor.

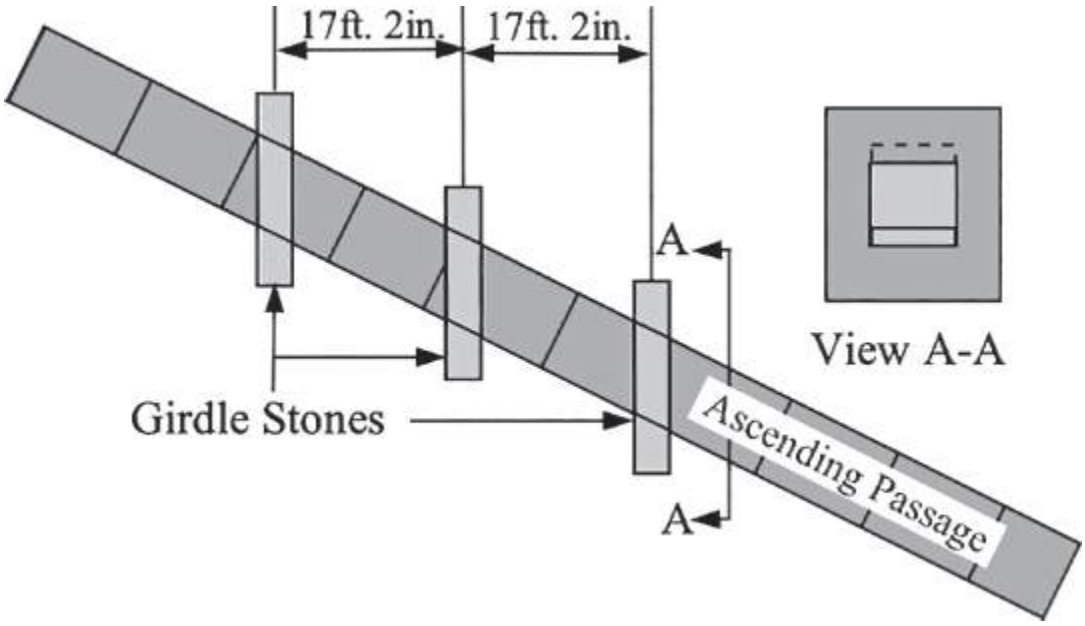

Figure Aa.2. Detail of the Girdle Stones in the Ascending Passage (Edwards 1975, 122; Kingsland 1996, 68–69). Graphic by C. Dunn.

Starting from the granite blocking plugs and going up the corridor, there is a small area before the first vertical seam in the walls. In the organ pipe analogy, this would correlate to an area known as the end correction zone, where the sound wave is not completely coherent due to interference from waves reflecting off the closed end of the pipe. This phenomenon makes the pitch sound slightly flat compared to strictly calculating the frequency (pitch) as a simple function of the length.

Moving up the corridor from there, five more vertical seams can be seen before the corridor ends at the opening to the Grand Gallery. Three of these seams are where the Girdle Stones are located. These features are equally spaced, within a variation margin of about a quarter inch. The remaining length of the corridor is precisely twice the on-center spacing as seen in the Girdle Stones.

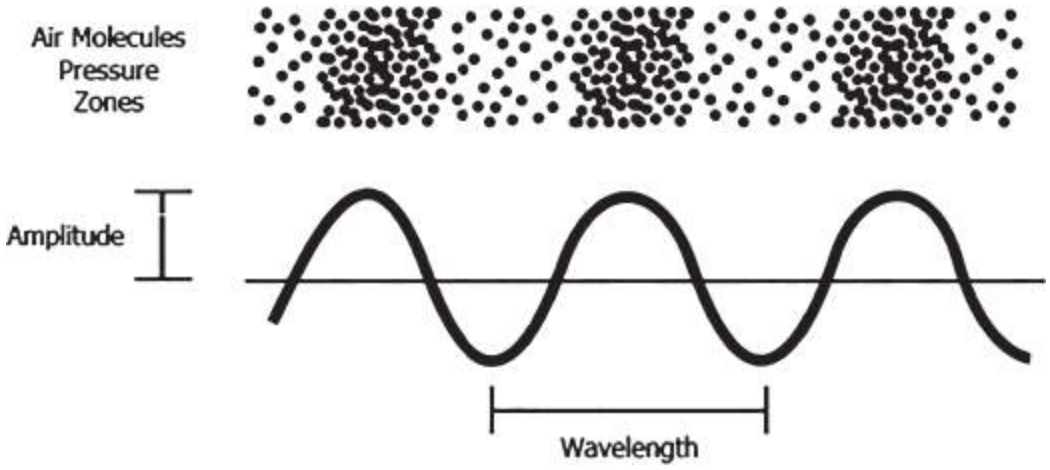

Figure Aa.3. Pressure zones within the Ascending Corridor.

If one visualizes a resonant-sound sine wave passing through this organ pipe (see Figure Aa.3), these vertical seams and the Girdle Stones are located within half an inch (1.27 cm) of the estimated location of the nodes where pressure waves would impact the side walls of the corridor.

In the organ pipe analogy, calculating the frequencies for multiple nodes within the pipe yields an interesting correlation. Six nodes generate a frequency around 33.9 Hz, a frequency very close to a King's Chamber axial mode length calculated at 32.7 Hz. Similarly, the calculation for twelve nodes in the pipe equals 65.2 Hz, which compares very favorably with the main resonant frequency, around 65.4 Hz, for the width of the King's Chamber. If one considers end correction in the estimates, which makes the pipe sound slightly flat (a lower frequency), these numbers become even closer to alignment. Is this a coincidence or intentional? I suggest the Girdle Stones' function is to provide a solid reflective surface to emphasize and/or stabilize this particular frequency.

THE GRAND GALLERY AND THE RESONATORS THEORY

Once again, standing wave resonances are primarily found in parallel walls. In the case of the Grand Gallery, the only parallel surfaces are the corbels, specifically the side-to-side orientation in the gallery. Since the roof has a sawtooth construction detail, it serves to reflect sound down into the Gallery, where Dunn postulates resonators may have been located. Dunn further suggests the resonators were placed between the corbels. This raises

the question: At what frequencies would resonances naturally occur at these specific locations (Dunn 1998, 168)?

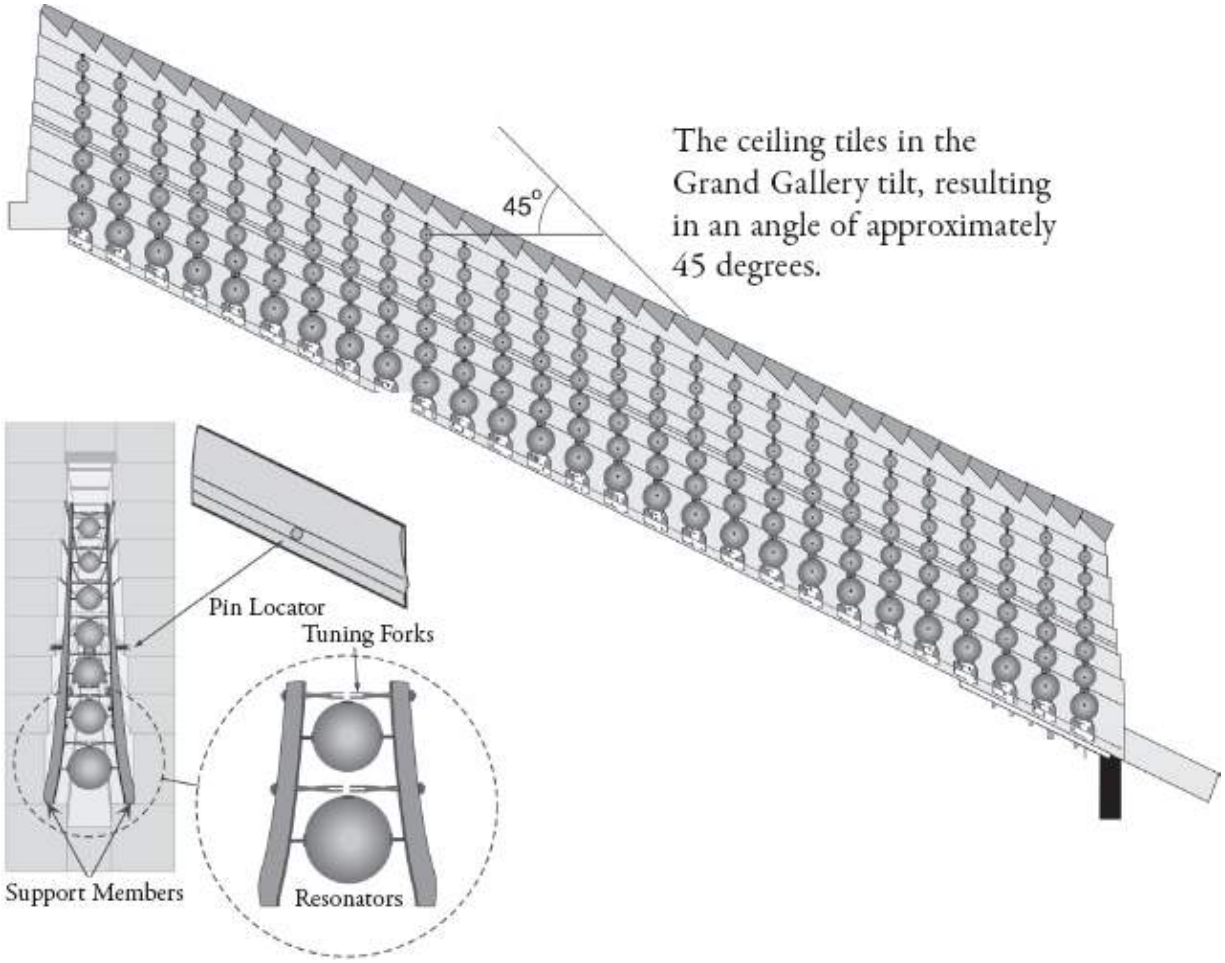
The ceiling tiles in the Grand Gallery tilt, resulting in an angle of approximately 45 degrees.
45°
Pin Locator
Tuning Forks
Support Members
Resonators

Figure Aa.4. The Grand Gallery and resonator arrays as suggested by Dunn.

Since the data from laser scans made by the Time Scanners team in 2014 (featuring structural engineer Steve Burrows, Caitlin Stevens, Dallas Campbell, and others) is unavailable to the public, only very rough estimates of the corbel dimensions can be made. Extrapolating an estimate from Petrie's measurements and the beautifully detailed drawings of Vito Maragioglio and Celeste Ambrogio Rinaldi yields the following approximations.

Maragioglio and Rinaldi state that the blocks of stone in the walls are corbelled inwards by 2.4–3.9 inches (6–10 cm) on each side. Since the inset

is on both sides, this would mean approximately 4.72–7.87 inches (12–20 cm) per level as one counts upward (Maragioglio and Rinaldi 1965).

Another way to estimate these dimensions is to use Petrie's measurements of the floor, including the channel and the ramps on each side (Petrie 1883, 25). The width of the top corbel (the roof) is the same as the channel. Dividing this into an equal inset for each of the level changes yields an average estimate of 5.89 inches (14.96 cm). This dimension falls comfortably within the range suggested by Maragioglio and Rinaldi. For simplicity, I have used the 5.89 inches to generate the following chart.

	Width	Frequency	Modern Music Note
Corbel 7 / Roof	41.26	327.4	E4 minus 12 cents
Corbel 6	47.15	286.5	D4 minus 43 cents
Corbel 5	53.05	254.6	C4 minus 47 cents
Corbel 4	58.95	229.2	A#3 minus 29 cents
Corbel 3 w/ slot	64.88	208.2	G#3 plus 5 cents
Corbel 2	70.74	191.0	G3 minus 45 cents
Corbel 1	76.63	176.3	F3 plus 17 cents
Floor level > Wall to Wall	82.53	163.7	E3 minus 12 cents

Figure Aa.5. Musical frequencies of the Grand Gallery corbels.

If the resonances of these "vases" were tuned to the corbel dimensions, it can be seen that the frequencies precisely frame an octave range from approximately 164 to 328 Hz. This octave is divided into eight "notes," including the channel and shelf areas. It should be pointed out that the roof, channel, and shelf area are all direct multiples of the Petrie cubit. The top end of this octave, 328 Hz, may also correlate with Thomas Danley's "very rough estimate of 300 Hz" for resonating the blocks in the King's Chamber ceiling (Danley 2000).

THE RESONATORS—VITRUVIUS AND *ECHEA* (RESONATING URNS)

Conversations with Chris Dunn over the years have indicated that there is some debate over ancient knowledge and use of tuned vases as resonators in

large architectural structures. He has asked me to take a moment to discuss the writings of the Roman architect and engineer Vitruvius. In his seminal work, *De architectura*, book 5, chapters 4 and 5, Vitruvius provides an extensive description of *echea* (resonating vases) used in Roman and Greek theaters to control the frequency content of the sound and reverberation in the space for speech intelligibility reasons.

Vitruvius also provides insight into the lineage of the transmission of information regarding the proper usage of these resonating urns. In the text he names Aristoxenus as a source (Vitruvius 1914, 139–46). The Greek philosopher Aristoxenus (c. 375–335 BCE) is primarily known for his musical treatise, *Elements of Harmony*. His teacher, probably Xenophilus, clearly introduced him to Pythagorean doctrine. Xenophilus was a Pythagorean philosopher and musician who lived in the first half of the fourth century BCE. Tracing the transmission of this knowledge directly back to the Pythagorean lineage is significant.

Pythagoras (c. 570–495 BCE) was in Egypt some 175 years before Alexander the Great, the rise of the Greek Ptolemaic Dynasty, and the early formation of the famous Library at Alexandria or in other words, before Greek influences came to dominate Egyptian thought.

Iamblichus (c. 250–325 CE), in his book *De Vita Pythagorica* (On the Pythagorean Life), and Porphyry (c. 233–305 CE), in his book *Vita Pythagorae* (Life of Pythagoras), both tell us that Pythagoras was in Egypt for 22 years. That ended when Egypt was conquered by the Persian king Cambyses in 525 BCE and Pythagoras was captured and taken to Babylon.

Since no texts written by Pythagoras are known to exist, we do not know exactly what he studied during his 22 years in Egypt. Therefore, it is possible, but not proven, that this knowledge regarding the use of resonating urns originated in Egypt.

Getting back to the Grand Gallery, a brief comment on the sawtooth roof design is in order. The angles present in the roof reflect the sound back down into the area where the resonators would have been. Additionally, when sound waves in air (pressure waves) come in contact with a hard surface, such as the limestone or granite inside the pyramid, there is no phase change upon reflection. Further, if one views the collection of molecules as a fluid, either air or water, the concept of energy density enters the discussion. Consequently: “The energy of the molecules reflecting off the wall adds to that of the molecules approaching the wall in the volume

very close to the wall, effectively doubling the energy density and hence the pressure associated with the sound wave" (HyperPhysics n.d.). This phenomenon applies to the sound reflecting off the corbels as well.

Putting this all together, the corbels are tuned to a specific octave where the frequencies are all directly related to other significant features found in various parts of the pyramid. Further, certain physical phenomena appear to be utilized to amplify the intensity of these resonant waves. This is especially true in the confined space between the corbels where Dunn has speculated resonating urns may have been located.

RECORDING OF AN IMPULSE RESPONSE TEST INSIDE THE GRAND GALLERY

In 2018, I was on tour with Chris Dunn and performed an impulse response test inside the Grand Gallery. I found a loose board at the landing just above the entrance to the Queen's Chamber corridor and recorded a heavy foot stomp on the board with a Tascam DR-40 digital recorder.

Plate 15 is a screen capture from the spectral analysis program of the frequency distribution and the intensity of the acoustic response within the gallery. The spectrogram covers about 2.7 seconds of the recording. The vertical axis denotes the frequency and the horizontal axis is time. The colors denote the relative intensity of the sound at that specific frequency. The sweeping arcs on the upper right are my wife, Helen, saying "wow" in response to the impressive sound made by the foot stomp as it echoed around inside the pyramid.

Starting at the left side of the scan, there is a brief dark area just before the foot stomp, which is the vertical line with the main flare at approximately 88 Hz (yellow/red is louder than the blue areas), An additional early reflection in the mid-60s Hz range can be seen immediately forming as reflections begin to build. The Grand Gallery corbels' resonant octave frequency range, estimated earlier in this paper and covering the octave from approximately 164–328 Hz, can also be seen as discrete frequencies forming a vertical stack that dissipates rather quickly. An additional two octaves of overtones are also evident in the spectrogram.

Below the main foot stomp horizontal band there is a rather peculiar absence of sound, and below that there is a series of pulsing infrasonic frequencies. These cover a rather wide bandwidth from 5–20 Hz. Notice the

pulse is present in the spectrogram before the foot stomp, then spikes for a fraction of a second during the foot stomp impulse. These infrasonic frequencies then continue to pulse strongly long after the initial decay time for the initial sharp sound stimulus. Examination of other sections of the recording indicate these infrasonic pulses may be essentially continuous, as they were present even when the Gallery was quiet.

The presence of this infrasonic pulsing suggests there is more research that needs to be done to explain the cause of the pulses. For example, city noise would appear as a relatively constant level of activity, not pulses as seen here. The wide bandwidth of these pulses also remains confusing at this time. Danley also commented on the presence of significant infrasonic activity in the King's Chamber. It remains to be seen if this can be connected to Dunn's assertion that the pyramid is designed to be a sympathetic resonator with the natural earth hum or other seismic sources.

THE ANTECHAMBER COMPLEX

I have not modeled this section of the pyramid. The antechamber complex, as it exists today, is basically a hollow shell of the original. Common theories include missing elements, such as movable slabs of rock intended to seal the entrance to the King's Chamber. Some authors, including Chris Dunn, have postulated that it functioned as an acoustic filter, while others think some other type of technology may have been mounted in there that was removed long ago. It is outside the scope of this paper to speculate on these theories, so I will move on.

As one leaves the Grand Gallery, the dimensions of the entrance to the Antechamber Corridor are nearly the same as the exit into the King's Chamber. Since the central room is much larger than the corridors, the chamber complex as a whole probably exhibits airflow changes in both pressure and velocity, in accordance with the Venturi effect. For example, leaving the Antechamber complex and heading into the King's Chamber, the passageway narrows significantly relative to the size of the Antechamber itself. This detail should result in an increase in the speed of the airflow, along with a concurrent lowering of the pressure. These changes will shift the frequencies of any sound wave passing through. Frequency is dependent on the temperature, pressure, and humidity of the environment. Additionally, this also affects the speed of sound in frequency

calculations. While I have generally ignored detailing these variables elsewhere in this paper, this provides a good time to acknowledge a limitation on the estimates provided.

THE KING'S CHAMBER

It is common to hear researchers speak of a particular dominant resonant frequency in the pyramid. My research indicates there are a vast number of frequencies present, including many that are clearly related frequencies. It is Chris Dunn's thesis, and I agree with him, that the pyramid functions as a complete system, with interactions that become dauntingly complex to contemplate, let alone claim to completely understand.

To illustrate the point, Figure Aa.6 is a computer simulation of the first 4.5 octaves of resonant frequencies in a room the size of the King's Chamber. At first glance, the chamber itself appears to be a simple box, yet the complexity of the resonant environment is, hopefully, evident.

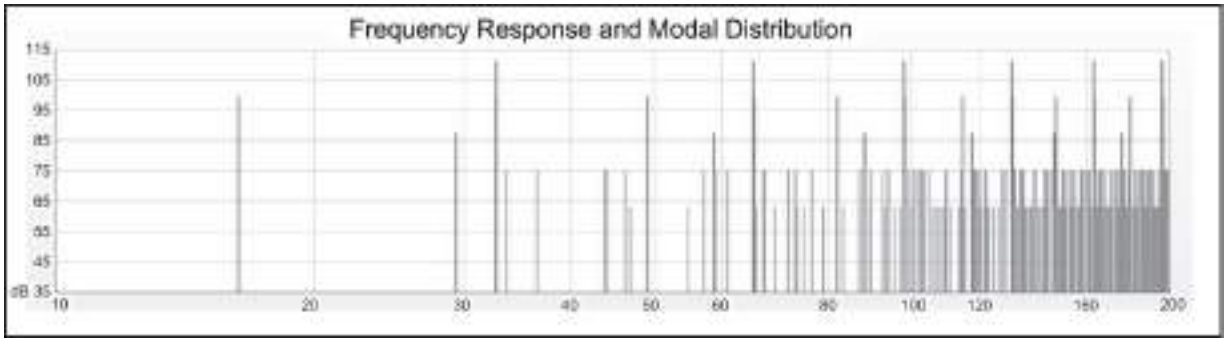

Figure Aa.6. Simulation of King's Chamber first 4.5 octaves

In acoustic analysis, these resonant frequencies are known as room modes or eigenvectors. At the risk of boring the reader, perhaps a quick minute explaining what these are and how they work would be useful.

1. **Axial** modes tend to dominate the modal response. A rectangular room has three fundamental axial modes, which are formed between each pair of opposing wall surfaces.
2. **Tangential** modes involve any pair of parallel surfaces. They can bounce around all four walls, or two walls plus the ceiling and the

floor. They are typically about half as strong as axial room modes.

3. **Oblique** room modes involve all six surfaces: all four walls, the ceiling and the floor. They are generally about one quarter as strong as axial modes and half as strong as tangential modes. Oblique modes often become overly excited in the low frequency (bass) ranges.

Room modes are also the main cause of sharp peaks and dips in the frequency response and can vary significantly depending where one stands in the room. The details of these interactions are known as nonlinear acoustics and can create significant amplitude changes in the acoustic environment. Further, a room with hard surfaces will exhibit "high-Q" characteristics, manifesting as sharply tuned resonances. These factors combine in ways that mean you might not hear certain frequencies at all, or hear them up to twice the volume, compared to a location a mere few feet away. These effects are most pronounced near the walls and in the corners.

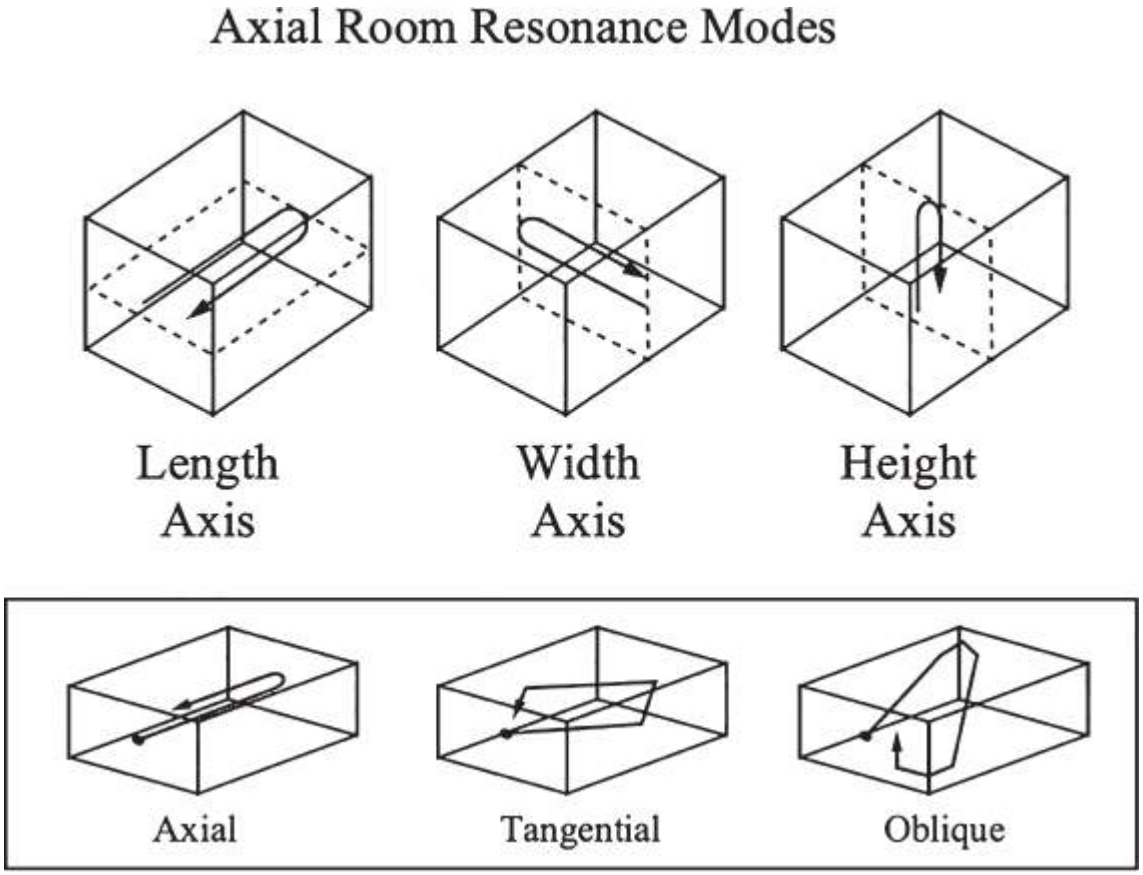

Figure Aa.7. The main modes (eigenvectors) in the King's Chamber.

This phenomenon is probably most applicable to the claims made by some authors that the coffer resonates in harmony with the King's Chamber. I maintain there is simply not enough data to know if this is true. It may be possible if there are significant additive waveform interactions in that part of the room. Conversely, the coffer resonance could be negated by specific interactions. The answer to these possibilities is dependent on one's location in the room, as was detailed in the above paragraph. Since the coffer has probably been moved from its original location, this line of inquiry may never be settled with any degree of certainty.

THE KING'S CHAMBER AMPLIFIERS AND THE DANLEY 30 HZ EXPERIENCE

Using Petrie's measurements, it is clear that the chamber's length is twice the width. This results in a strong additive emphasis at certain frequencies. By definition, two sounds with either half or double the wavelength form notes an octave apart from each other. When these octave sound waves interact, the result almost doubles the amplitude of either wave individually. It seems possible the ancient architects were aware of this and chose to design the room to take advantage of this passive amplification effect. Researchers in a field known as archaeoacoustics constantly surprised by the sophistication found in ancient sites around the world.

Figure Aa.8 shows how this octave wave interaction would look on an oscilloscope. The top wave is the chamber's axial length frequency and the middle wave is the axial width frequency, exactly an octave higher. Notice the graphs show these waves to have an amplitude of +1 to −1. The bottom wave on the graphic shows the result of combining these waves. The combined waveform shows an overall loudness increase of almost +2 to −2, basically doubling the intensity of either wave by itself.

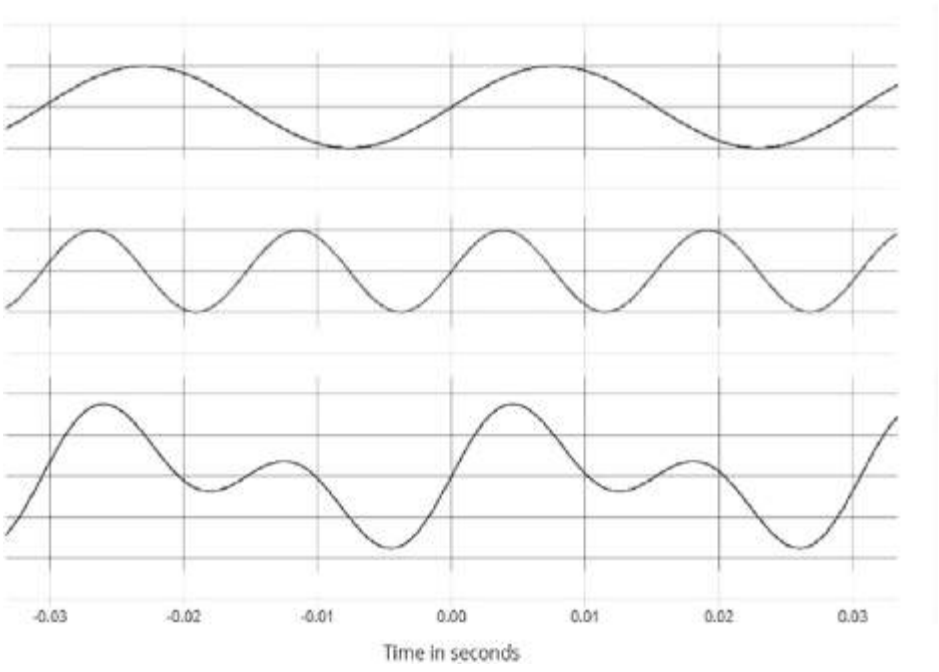

Figure Aa.8. Octaves. Graphic generated using Academo's online beat frequency generator (Academo n.d.).

This may explain the comment made by Thomas Danley when a frequency "about 30 Hz" got so loud it caused the pyramid to vibrate and they had to shut down the experiment (Danley 2000). Various models indicate the axial width dimension is creating a resonance at about 32–33 HZ, which is emphasized by the octave of the axial length. Since axial modes carry the most acoustic energy in a room, I suspect they could form a significant resonant effect similar to Danley's experience.

Furthermore, this frequency and an octave of it are both present in the nodal analysis presented in the Ascending Corridor section and the Girdle Stone spacings. It seems plausible these two sections of the pyramid could interact and reinforce each other. If that was the case, it seems significant that Danley reported it shook the entire pyramid.

To conclude this section, I would like to draw attention to the relationship between the horizontal dimensions found on the floor (length & width) and the height of the chamber. The height of the chamber is half the length of a diagonal line drawn corner to corner on the floor. Using the Pythagorean theorem, it can be seen this has an accuracy of less than a quarter inch. Hence, the axial mode for the height and the diagonal tangential mode in room are directly related. This also creates an additive

emphasis at a specific frequency, in this case approximately 58.8 to 60 Hz. In the same manner as the 2:1 ratio seen in the King's Chamber length and width, this ratio of height to diagonal of the floor creates another significant increase in the amplitude (energy) within the chamber. This frequency is very close to an octave of Danley's "about 30 Hz" and probably contributed to the phenomenon. There are other Pythagorean triangles in the King's chamber, but they involve oblique modes that are much weaker.

REGARDING DANLEY'S F# CHORD

Over the years, much has been written on Danley's comment regarding an "F-sharp chord" in the King's Chamber. I consider this to be a misunderstanding of his statement. As was mentioned earlier, I can see no good reason, nor any evidence, that the ancients used our contrived modern Western musical scale. This becomes obvious in the Grand Gallery corbels analysis and the foot stomp impulse measurements. Further, the modal analysis and computer simulations indicate frequencies that simply do not directly correlate to modern notes. The next chart superimposes the main resonant frequencies in the chamber over a modern keyboard.

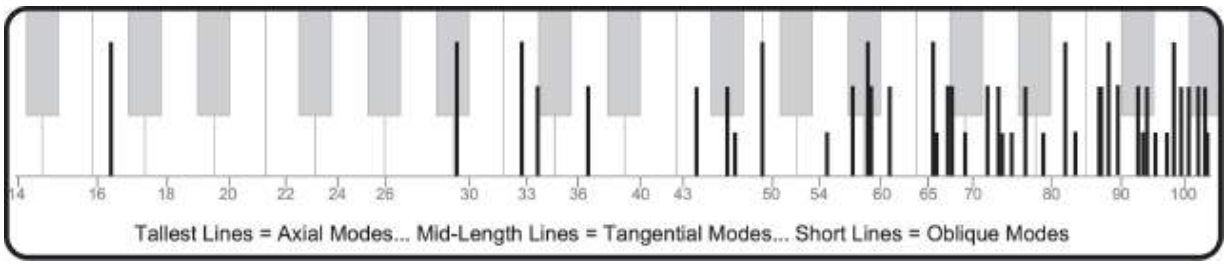

Figure Aa.9. The dominant modes compared to a modern keyboard.

A modern F# chord consists of the notes F#, A#, and C#. Using multiple computer modeling programs, frequencies corresponding to these precise notes are not to be found in the King's Chamber. For example, the models show an F# plus 2 to 27 cents in the chamber. Interestingly, I have measured this frequency in the Red Pyramid at Dahshur (F# plus 18 to 23 cents) as well. Similarly, the A# appears in the King's Chamber as A# plus 10 to 19 cents in the models. The C# is more problematic. It is missing in the lowest octave, a near miss in the second octave (C# minus 2 cents), and

rather inconsistent for the next three octaves. Consequently, I suspect Danley's statement was intended as an illustrative generalization and other authors are taking it too literally.

THE UPPER CHAMBERS—THREE FUNDAMENTAL OBSERVATIONS

1. A pattern exists showing a direct relationship between resonant waves in the King's Chamber and the overall height of the Upper Chambers.
2. Another pattern exists showing a paired relationship of pressure zones that could facilitate vibrational movement of the blocks themselves.
3. Granite under stress can release significant amounts of energy.

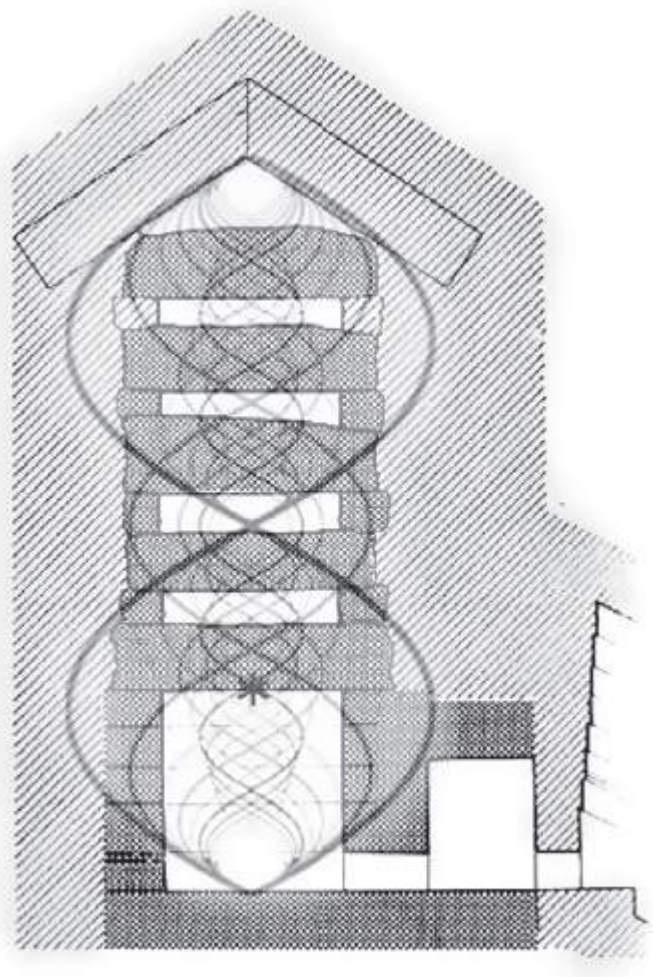

Figure Aa.10. Visualization of harmonically related frequencies at full resonance in the Upper Chambers.

Figure Aa.10 shows the relationship of the height of the Upper Chambers, including the King's Chamber, to the height of the King's Chamber itself. There is a simple equation that illustrates this relationship: 0.5 (King's Chamber height) × 7 = height of the Upper Chambers complex.

The "× 7" in the above equation possibly indicates a preference for odd harmonics. The five blocks within the Upper Chambers are essentially flat on the bottom yet are very rough and irregular on the top. The flat surfaces would be more conducive to the creation and sustainability of standing waves. It is also possible the irregularities seen on the top of the blocks may have been a way to tune them. Removal of the material would be analogous to adding or subtracting water in a glass, thus changing its tone when struck. Since the blocks were never intended to be seen, it is puzzling why the ancient builders would do that much extra work unless it was necessary for some reason. This preference for odd harmonics is also seen in the Ascending Corridor. Due to the presence of the blocks in the lower end of the corridor, it is essentially a closed-end pipe that will produce resonant waves at the fundamental tone along with only odd harmonics.

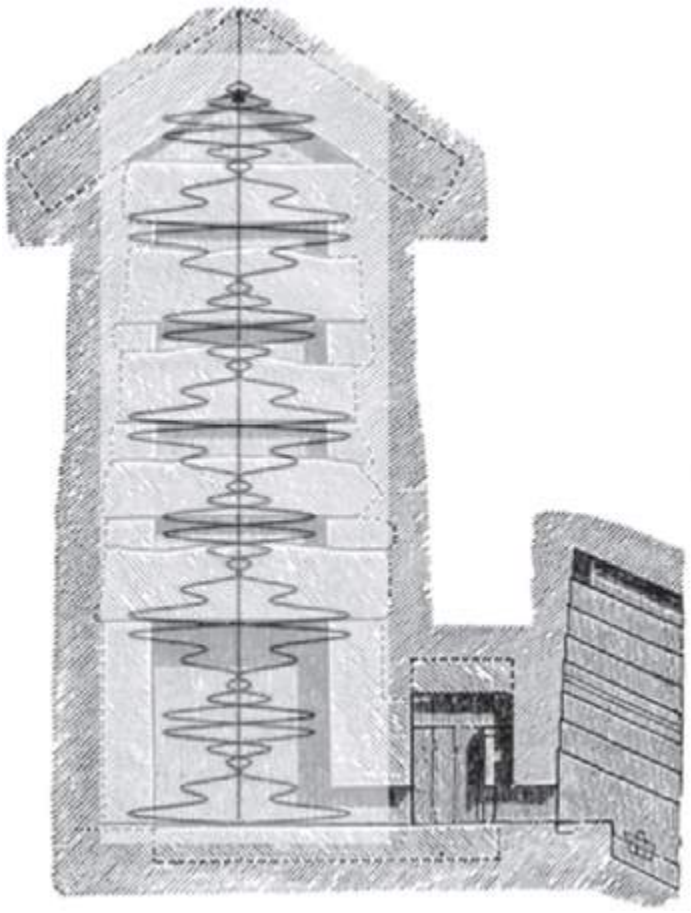

Figure Aa.11. Alternating high-pressure and low-pressure zones in the Upper Chambers.

Figure Aa.11 is a visualization composed of two elements. The waveform is a composite of a fundamental tone along with the 3rd, 5th, and 7th harmonics. That wave was then reflected back down to generate a waveform envelope that simulates what it would look like within the Upper Chambers. This produces a pattern of relatively higher and lower pressure zones. As can be seen, a standing wave composed of this harmonic structure aligns these zones in pairs, where a high-pressure zone above the block is countered with a lower-pressure zone below the block, or vice versa. This would probably enhance the ability of the blocks to flex or vibrate.

FINAL PIECE OF THE PUZZLE—GRANITE UNDER STRESS

Laboratory tests performed separately by Professor Mamoru Kato in Japan and Friedemann Freund at NASA have shown that granite, when properly stressed, will release enough energy to ionize the air surrounding the sample. It takes energy on the order of tens of thousands of volts per square inch to produce this effect. See color plate 5 (Kato 2007).

Freund's research repeatedly comments on the subtle forces necessary to release significant energy from within granite. Lab tests have shown forces roughly equivalent to a hand hit or foot stomp are enough to trigger the release of energy in granite. Since the breaking of bonds and the ensuing current flows all occur at quantum energy levels, the range of motion necessary to achieve this release of energy is measured in angstroms. A major variable to consider here is the stunning speed of sound in granite, approximately 13,309.8 miles/hour (5,950 meters/sec), as compared to a leisurely 767.3 miles/hour (343 meters/sec) for the speed of sound in air at normal ambient conditions (The Engineering Toolbox 2022). Since sound is a pressure wave, the faster the speed, the harder it impacts any object in its path. The effect of this dramatic difference here is worthy of contemplation.

Given that there are literally thousands of tons of granite in the Upper Chambers, one intriguing question remains to be tested: Can sound vibrations, properly tuned to the resonance of large granite blocks, actually vibrate the granite enough to release the energies? One key indication that this is possible could be the Ringing Obelisk at Karnak, where a simple hand hit causes a huge (70–80 tons or more) block of solid granite to ring like a bell.

CLOSING SUMMARY

This paper has explored areas in the pyramid that exhibit a rather unique and intriguing set of acoustic properties. Certain frequencies stand out as being produced, enhanced, or amplified by multiple aspects of the design and dimensions throughout the structure. Further, I believe this supports a conclusion that the pyramid is functioning as a system. To paraphrase the research of Chris Dunn, it appears to be a device, not just a collection of rooms and passageways. It is my sincere hope that other researchers interested in this line of thinking will find this commentary useful cannon fodder in their efforts and discussions. Finally, if serious acoustical testing

of the pyramid will someday be done, answers to many of the questions posed throughout this paper may perhaps be known.

MAY 2022

ROBERT VAWTER graduated *cum laude* from San Jose State University with a degree in Archaeology & Anthropology in 1998.

Beginning in the mid-1970's he worked over twenty years as a sound engineer and lighting technician in small music venues and large auditoriums for local and national touring bands. Eventually this work expanded into the more analytical realms of sound in technical theatre and recording studio applications.

Combining his degree in archaeology with his expertise in how sound behaves in a wide variety of venues, Vawter was drawn to the study of ancient acoustics and the Pyramids of Egypt. Scholastic studies were augmented by on-site research in Egypt with Dr. Abd'El Hakim Awyan in 1996 and 1998.

Vawter's acoustic research in the Red Pyramid at Dahshur captured a range of frequencies that he used to create a composition titled, "The Dahshur Frequencies." A sought-after presenter at numerous conferences, including the National Convention for the Society for the Anthropology of Consciousness, he was also a frequent guest lecturer at San Jose State and Sacramento State Universities. In 2019, Vawter became a member of the GeoCosmo Research Group.

Robert Vawter passed away unexpectedly on September 17, 2023. He will be greatly missed.

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* One Royal Egyptian cubit = 20.610 inches (0.523 m)

APPENDIX B

USING SEMICONDUCTOR PHYSICS TO FORECAST EARTHQUAKES

FRIEDEMANN FREUND, PHD

I came to Christchurch to talk about earthquakes. There's no better place in the world, I would say, to talk about earthquakes, and particularly, I want to give you hope. So, if you look at the photo of the New Zealand islands, it looks so peaceful and classic—you see Christchurch on the left side. But on certain days, occasionally, the Earth speaks to us with a very violent voice, and many of you have gone through this experience. I would like to present you with a question. What if we would be able to see these earthquakes coming days before they arrive?

Now, I worked for the past 30 years for NASA in California. Before this I was a professor in Germany, and during that time I was doing things that at first had no relationship to earthquakes. I was studying single crystals with my son, Nino, who was a director of nanotechnology and advanced space science at NASA Ames—and he passed away not long ago from a brain tumor. So much of what I am saying is in honor of my cooperation with him.

I started out working on very simple single crystals, totally, as I said, unrelated, never dreaming that what I was working on would one day have influence and importance for understanding earthquakes.

Magnesium Oxide. The simplest oxide material that exists, and I worked on it for a number of years, and I discovered something that everybody else had overlooked—had missed. And that is a defect. A type of defect in these crystals. And I should say that a defect in our world of solid-state physics is something that appears not as a crack, it is something that appears on the atomic, on the subatomic, realm. What I discovered was that in the crystal structure, like here, on the lower left side, there are these defects that are totally invisible. See color plate 2.

Until now we have no way to directly observe this peroxy defect, but when we do nasty things to the crystal they fall apart and produce electric charge carriers. Then I found the same kind of defects in other materials, including natural minerals either from the crust or from the Earth's mantle. Almost every mineral seems to have these, and if minerals have them, then, of course, rocks will have them.

So now I want to show you what you can do when you play around with rocks. So here you see a four-meter-long piece of granite in my laboratory at NASA Ames, and all what I am doing here is I put some contacts to the rock at the far end and the contact up here and I squeeze here. In the moment I start squeezing here, a current starts to flow through the unstressed rock. And if I put an ammeter in the circuit, I can measure an electric current. And here you see this example measure from this particular four-meter-long piece of granite. The green curve is the load. The moment I start to load the rock, the current begins to flow. The current rises very rapidly at low stress levels, saturates, and stays constant; actually—we have measured this over months—the current continues to flow if we keep it loaded. And if we unload it, the current goes away. See color plate 3.

Now those of you who have maybe heard about how semiconductors work, this is a behavior that is reminiscent of a semiconductor—the thing from which you build transistors and that becomes available in all electronics. Here at the bottom you see the schematic. On the right-hand side, the stress activates electrons and holes. Holes is the name for the defect and electrons are electronic particles that are generated and are necessary to be able to produce a thermistor. And we found out that electrons have to stay in the stressed rock volume while the holes flow out. They flow out at about 100 meters per second, which is about the speed of a jet landing at an airport. They are very fast. They propagate through it, and

in this particular experiment, the electrons have to come around through the wire and shake hands at the front end of this rock.

Now this is a combination of a semiconductor behavior of electrons and holes and an electrochemical battery, which means that we can separate the positive holes flowing through the rock from the electrons that flow through the wire. This is exciting and this is new. Now let's do the Duncan experiment. Take this rock and imagine that it would be sitting vertically in the Earth's crust and that this rock is not four meters long but a kilometer, five, ten, thirty, or fifty to a hundred kilometers long if we are in a subduction zone like we are in the North Island. See color plate 4.

If that end of that volume of rock is stretched out by the enormous tectonic force in the Earth, electricity is generated, and under certain conditions, electricity flows out of the stressed rock volume and into the surrounding rock. We have means to see these things flowing over distances of tens of kilometers under natural conditions. These are amazing properties that have never before been properly understood.

Now if these holes—because they have such unusual behavior—they have been given the name positive holes. I didn't give it; a good friend of mine gave it in the 1990s. If a current flows through something, it generates a magnetic field. If this current is constant and strong enough, even if it flows at a ten- or twenty- or thirty-kilometer depth, we can measure the change in the magnetic field at the Earth's surface. If the current fluctuates, which it most often does, then it becomes antennas emitting radio waves, and the ultra-low-frequency portion of these radio waves can travel through tens of kilometers of rock and we can measure it. And then you see here unipolar pulses, and these are amazing. I will show you an example afterwards.

If they start to flow into water, chemistry takes place. Electrochemistry. The water becomes stoichiometrically oxidized to hydrogen peroxide, the stuff you put on your skin when you have a scratch. You change the chemistry of water and you change the cation in iron, and iron content you change the fluorescence spectrum of the dissolved organic that is dissolved in all groundwater and river waters.

Then there are ground potential building up that we can measure. When we see this ground potential building up, if they reach a certain threshold, we start to see ionization of the air. First, positive ions are formed over an area about a hundred or two hundred kilometers wide; suddenly the air

becomes full of positive ions. At the same time, we see carbon monoxide seeping out of the ground. If the Earth continues to stress it, more and more charges come; we start triggering corona discharges. In the lab, we can photograph these little corona discharges.

Out in nature, they instantly form negative air ions that we can measure, the negative air ions that form ozone and other light products, and on the left side, you see there the infrared emission, and I will also show you an example of this. Then there are many, many perturbations in the uppermost atmosphere—a hundred to two or three hundred kilometers above the ground which have been reported extensively in the literature. Very few people, I would almost say nobody really, understood how these things are being generated. So now all these things we can now use to learn something about the stress state of rocks, deep below our feet. Far beyond the direct reach, we have to deduce their presence. From these indirect measurements we can establish these causality ranges linked together by chemistry and by physics.

So, I wanted to briefly mention this infrared emission. The infrared emission is when the charge carriers come to the surface and can recombine. During this recombination, these charge carriers release energy, and these two oxygens, they become suddenly about 20,000 degrees hot vibrationally and they emit bursts of infrared radiation. But one characteristic feature is that these charge carriers try to accumulate mostly on mountain tops. On hillsides, not in the valleys. See Figure Ab.1 and color plate 5.

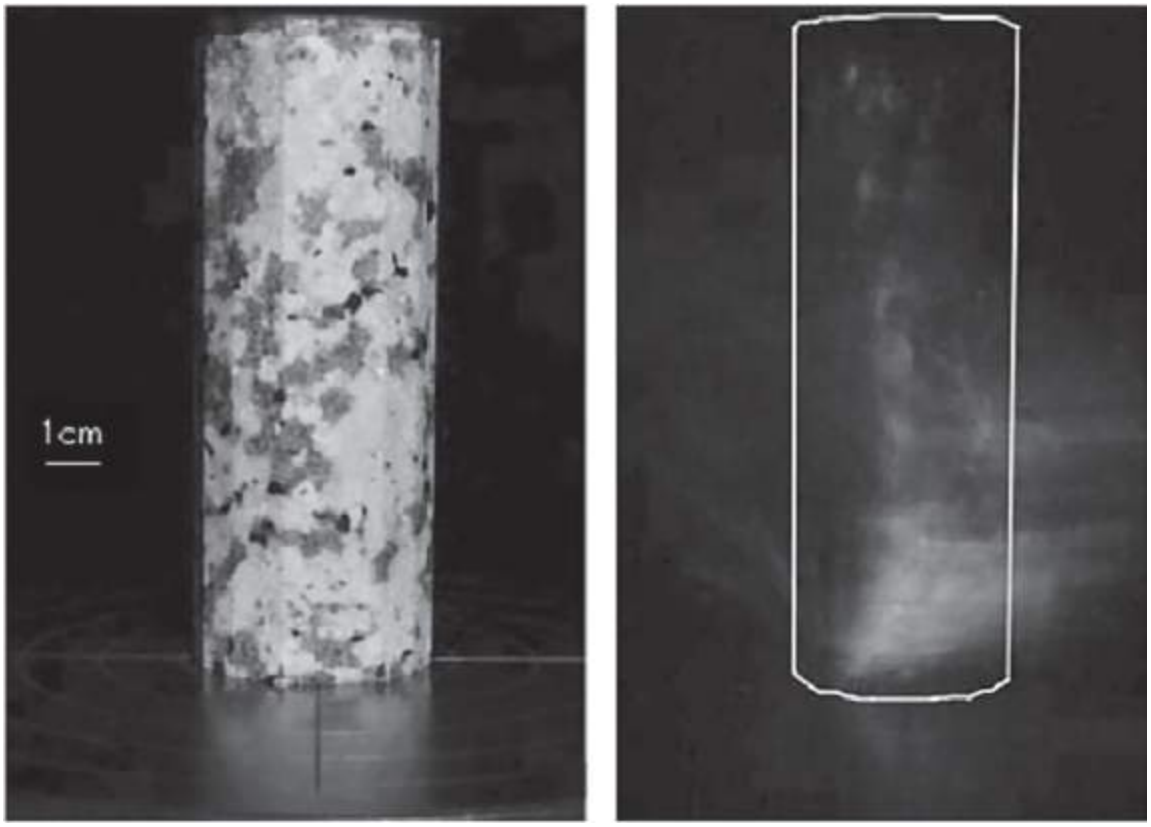

Figure Ab.1. Granite under stress generating enough energy to ionize air. (See also color plate 5.)

Now I want to show you here the result from a PhD thesis by Luca Piroddi in Italy, who had analyzed, I think, 18 months of Italy. Every night he looked for these anomalies, and prior to this earthquake in L'Aquila in 2009, he identified this anomaly that you see here in red. And here's a photograph of L'Aquila, a medieval town that was heavily damaged with a loss of life of more than 300 people, and to the left and to the right there are mountain ranges. The ones at Gran Sasso are the highest mountains in the middle of Italy. In the next slide you will see draped over exactly the same, this map of the thermal infrared anomalies as they are measured, three days before that disastrous earthquake. So, if anybody would have had the funding and the knowledge to analyze how important the analysis of this phenomena in real time three days before the earthquake was, they would have issued a warning and say something is brewing. Something must be happening 10 to 20 kilometers (6.2–12.4 miles) below our feet.

Now, next I want to talk about these unipolar pulses. Unipolar pulses are strange phenomena that, suddenly, within a fraction of a second, enormous energy—electromagnetic energy—is emitted from deep below. Only about 100, 150, 200 milliseconds long, [the pulses] shoot up, come down, and with a little wiggle, disappear. They are not yet fully understood; we are working on it.

Now here, the situation where a friend of mine, colleague Jose Haro, has operated for the past two-and-a-half years a station consisting of two search coil magnetometers, extremely sensitive, and what you see there is, in the subduction zone there is a submarine ridge where earthquakes are being generated. That ridge is subducted and disappears underneath the edge of the South American continent.

Now here is again the map, and you will see in a moment how these unipolar pulses are generated, and they are marked here. This is a period of about two weeks that you see, and here they come. A few 10 minutes distance from each other impact in groups. Then there is a day or day and a half of silence, no unipolar pulse, then the next group is coming again a little silent, or there is another blip from somewhere far away, and then there is a third group of these pulses coming. Now we have 2,500, more than 2,500 of these pulses, and they were associated with 22 magnitude-4 earthquakes, 3.5 to 4 earthquakes that happened in this subduction zone between the depths of 25 to 65 kilometers.

Jose Haro is able to predict a time window of 40 hours, three to six days in advance, depositing the information in a closed envelope with the president of his university and in all 22 cases that he has analyzed, he was right. It was quite remarkable.

So, I've started my presentation with asking "What if we can see earthquakes coming?" I think I can say I hope I have convinced you that by understanding the physics—and this is really new physics of how rocks respond deep below to the increase of stress, and how/what they are producing electricity, and how this electricity propagates through the Earth's crust—we can learn about the buildup of stress and we will be able to say, "Yes. We can see them coming, days before they arrive." We cannot be sure that every stress buildup will lead up to an earthquake because sometimes the Earth says, "I don't feel like rupturing, I feel like sliding." Then we would see the precursors and people would say that you have had a false alarm. No, we have not had a false alarm. The Earth has just had

another day. Another feeling. But in most cases, one thing we can make for sure is that in the future there will be no major earthquake that will hit any place in the world where we have the capability of measuring these precursory signals, will hit unannounced, unforewarned. So, the element of utter surprise that has been a plague until recently, and including the Christchurch earthquakes, will be over. Thank you so much.

FRIEDEMANN FREUND holds a PhD in Mineralogy and Crystalography from Marburg University, Germany, 1959.

Professionally, Freund is a Principal Investigator at the SETI Institute (since 1989), an adjunct professor in the physics department of San Jose State University (since 1989), as well as a NASA Associate at NASA Ames Research Center (since 1985).

Freund has published 300 papers in peer review journals. His research interests include defects in crystals; proton conductivity; defects in minerals caused by the incorporation of H_2O, CO_2 and other gas/fluid components; prebiotic chemistry in the solid state and origin of life; valence fluctuations in the oxygen anion sublattice in oxide/silicate minerals; and rock physics in relation to earthquake and pre-earthquake phenomena.

In 2014 he founded the GeoCosmo Research Centre, an independent think-tank comprised of scientists from around the world. A more complete CV of Freund's work can be viewed at the SETI Institute website.

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*Transcribed from a TEDx lecture presented by Freund in Christchurch, New Zealand, on December 12, 2016. Transcription and images copyright of Friedemann Freund and used here with his permission (Freund 2016).

APPENDIX C

LARGE-SCALE THERMAL ACOUSTIC GENERATOR

ERIC E. WILSON

ABSTRACT

This paper discusses a method of combining a man-made system with a unique natural phenomenon to generate power on a very large scale by harnessing a natural reaction common to the earth. This energy system taps into a very unique electrical phenomenon for clean and nearly free energy. Natural energy production is witnessed all around us. On (or within) the earth there are many types of natural electrical phenomena. Most are recognized in the electrical coupling between atmospheric charges and the earth manifesting as lightning. However, the most intriguing fact is that electricity is found at ground level, generated by the properties of certain types of rock in very large formations. Electricity has been observed and generated from stone if the stone is vibrated at the correct infrasonic frequency range. A thermoacoustic engine reaction matches the optimum frequency of power generation from stone.

I. NOMENCLATURE

Abbreviation	Meaning
eV	electron volt (energy)

Hz hertz

II. INTRODUCTION

The purpose is to present a combined concept. No technical data will be shared in this document. Evidence is presented from satellite observations and lab testing showing that the coupling of very large natural rock formations, or quarried rock, or stacked stone, can generate electrical currents and fields when exposed to compressional stresses or vibration. The induction of the vibration is proposed using a phenomenon of a well-published device known as a thermoacoustic engine. The combination of these two systems results in a high-voltage production of power within rock. These charges migrate to the surface and subsequently couple with the atmosphere and ionize the surrounding air. The reaction can be harnessed as a method of power generation.

III. THE THERMOACOUSTIC ENGINE

Study of thermoacoustic engine design has shown that these engines, when properly tuned, are capable of indefinite output with no active moving parts when provided minimal heat input into the hot section. A nonlinear response has been found that makes the engine purposefully unstable. The instability is exploited for the vibration, which is useful in energy production. The thermoacoustic engine reaction “stack” optimally resonates in a range of 3–6 Hz. This reaction frequency is very important as it matches the study we will reference in section IV.

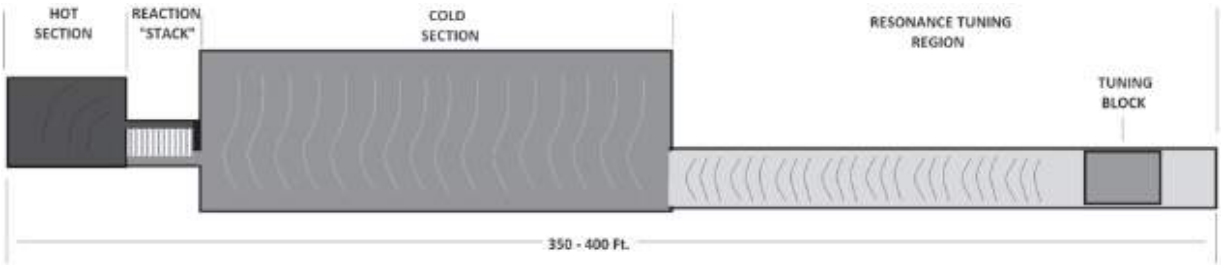

Figure Ac.1. Example scale of the large-scale thermoacoustic structure. Appendix C images credit: Eric Wilson.

The structure of the thermoacoustic engine proposed in this paper for large scale is depicted in Figure Ac.1.

The referenced work on thermoacoustic engines is credited to Purdue Propulsion. A published paper from the 2018 AIAA Fluid Dynamics Conference introduces a response that was revolutionary and somewhat unexpected as it was a nonlinear exponential response (Alexander et al. 2018).

Testing is being done on a small scale and on individual subsystems of the proposed system. No proposition has been made except in this paper for a very large-scale system. Reference is given from published work at Purdue University, where graduate students are working out the optimization of thermoacoustic engines. Details of that study will reinforce optimum tuning of these devices. With these experimental engines, scalability is being determined. Some proposed sizes are being discarded and considered as impractical for their task at hand because of the targeted pursuit of smaller machines to work with heat recovery from gas turbines. In contrast, larger-scale machines are considered in this paper for practicality in large-scale power generation (Alexander et al. 2018).

IV. FREUND EFFECT—ELECTRICITY IN ROCKS

The work of NASA's Friedemann Freund, PhD, has linked ground-level electrical anomalies before and during earthquakes, in specific types of rock formations, to what have been labeled in geophysics as earthquake lights. This phenomenon is known by those in Freund's close circle of researchers as the Freund Effect (Freund 2003, 2000).

Due to response levels with voltages high enough for ionization, the system will avoid traditional conductors to extract power from the reaction core. Instead, we will incorporate waveguides filled with a pure ionized gas excited to a plasma state. When gasses are excited to their plasma state, they perform as very high-energy capacity superconductors.

The dream of many to harness energy from sources such as lightning has not yet been achievable. We are not exactly harnessing lightning, but it is a good analogy.

More and more, examples in nature have been used in the design of advanced technologies. For example, Apple has exploited this engineering tactic in the discovery of their fractal antenna. This antenna mimicked the

natural random structure of a tree to achieve an antenna with superior reception.

A. Solid State Processes

There are two main elements to the theory of earthquake lights. Those are acoustic vibrations and electrical charges. Stress and vibrations in igneous rock create electrical charges. This electrical phenomenon is not well-known outside of earthquake lights research. One minor part of the reaction is the piezo effect, but it is not the primary driver of electricity generation in vibrating rock.

Granite has the best observable reactions. In the lab example in Figure Ab.1 and color plate 5, granite under stress generates electrical charges sufficient to ionize air before failure in the sample. Oxygen atoms reacting produce 630 nm photons in the 1.97 eV range. As the rock is heavily stressed, in this case to a breaking point for highest output, ionic bonds in quantum valence levels break and then recombine. There is a releasing of energy in this process, and the charges migrate to the surface (Freund 2009).

B. Peroxy Anion Effects in Stone

When granite is formed by heat and cooled in the presence of water, hydroxyl bonds are formed (Freund et al. 2021).

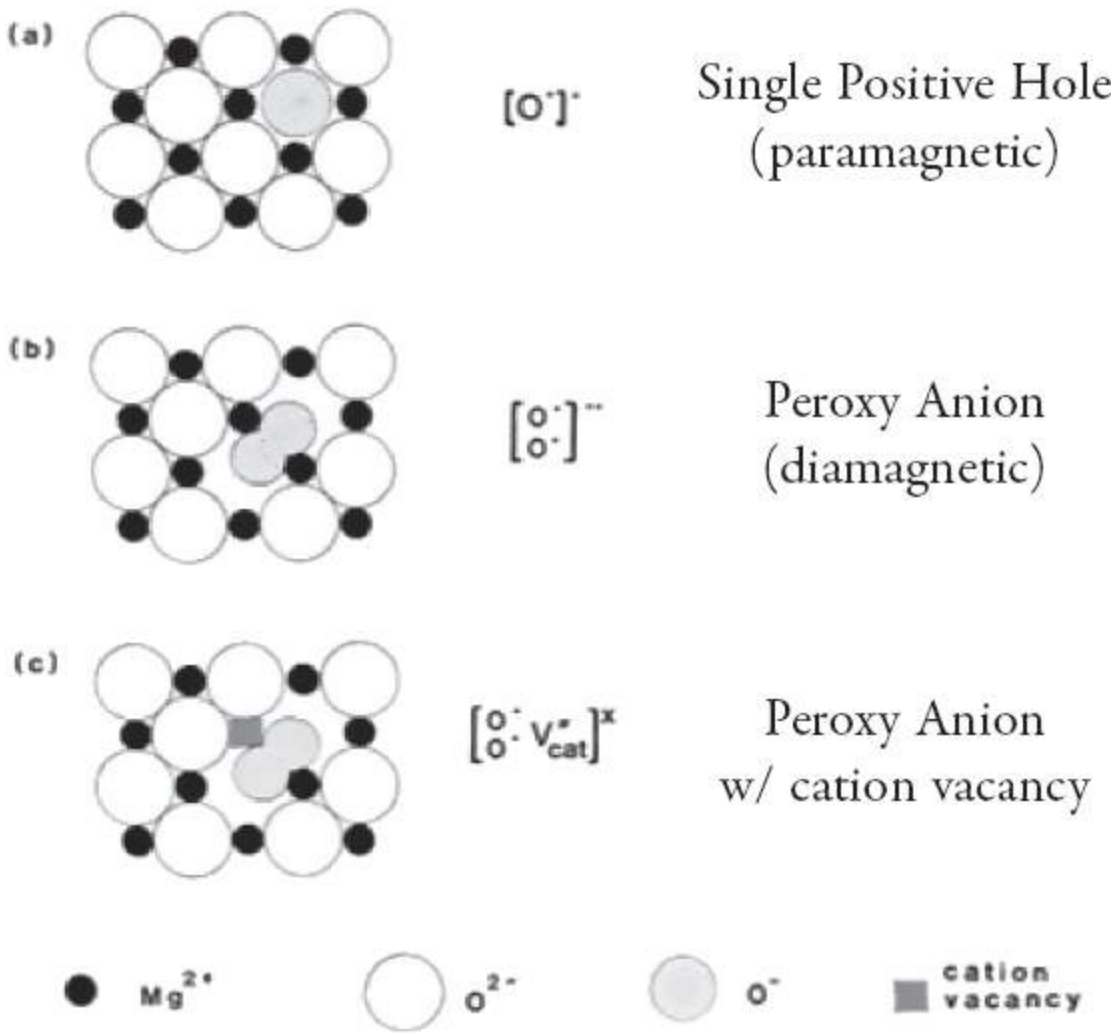

Figure Ac.2. Peroxy anions form in granite. (Bruce V. King and Friedmann Freund 1983)

C. Seismic Vibration Response

When seismic activity disturbs the hydroxyl bonds, electrons seek to form new bonds (Freund et al. 2021).

D. Power Generation

The schematic in figure Ac.4 depicts the testing apparatus used by Freund and the propagation of ionization (Freund 2000).

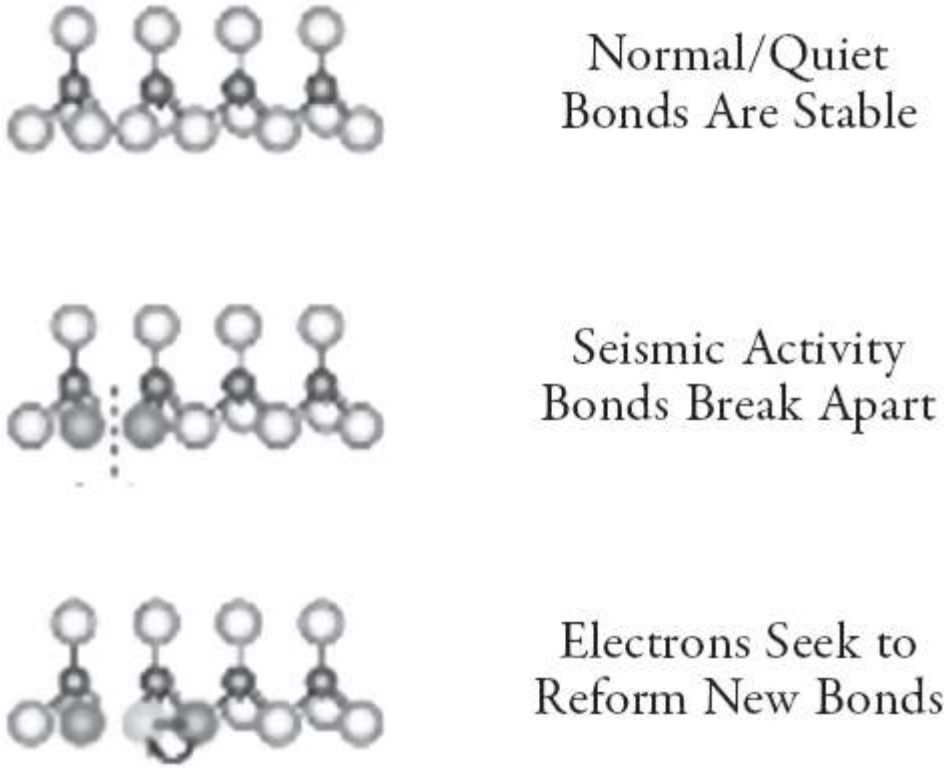

Figure Ac.3. Hydroxyl bonds seek to form new bonds.

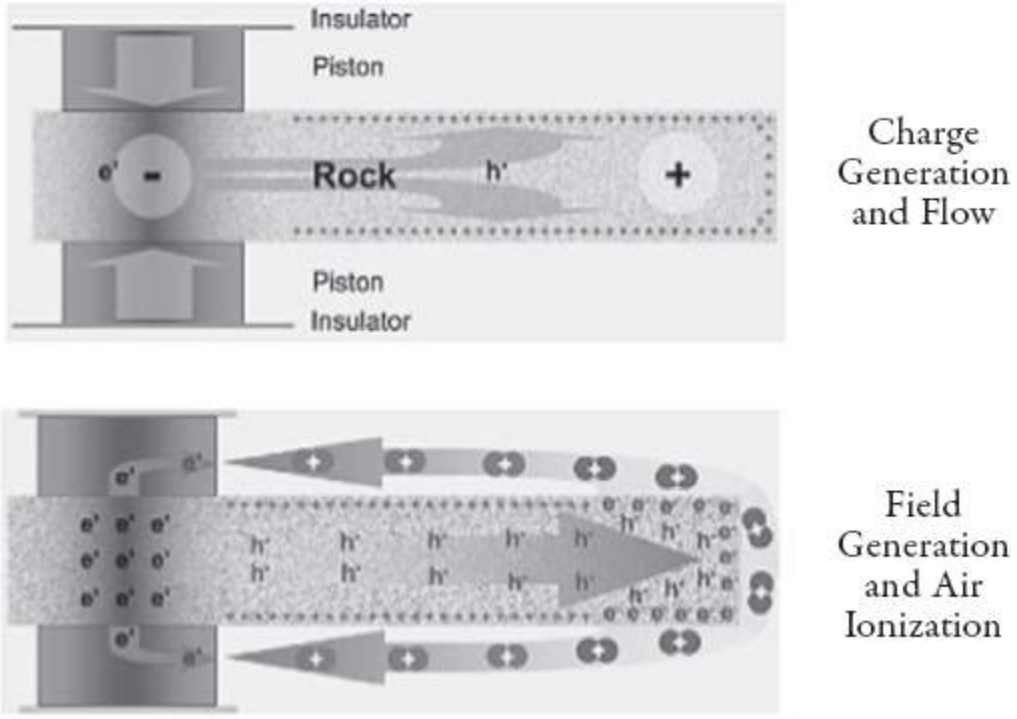

Figure Ac.4. Freund's test rig propagation schematic.

V. ACOUSTIC COUPLING

The thermoacoustic engine reaction optimally occurs in a range of 3–6 Hz. This reaction is also optimum for the Freund Effect reactions measured in igneous rocks, such as basalt, gabbro, granite, and certain types of feldspars, for producing electricity. Earthquake infrasonic signatures are in this frequency band when at peak activity and are synchronous with the measurement of these energy production reactions recorded by ground and satellite studies (Piroddi et al. 2014; Aizawa 2004).

Amplification can be achieved in the production of energy when the target rock is machined and tuned. A stack of stone subjected to compression from a mass structure will exhibit the greatest output. The stones can be tuned to a harmonic of the proposed acoustic engine well above 3–6 Hz range. Resonance chambers are used to produce the desired frequency environment as long as there is a harmonic link to the source reaction frequency. The primary system overall has no moving parts.

The Freund Effect has measured the energy being transmitted over 100 miles and migrating to the highest point in topographical formations of rock. The potential difference has been estimated in natural production up to 100 Kv and up to 6M amps. It is conceivable that an array of similar tuned devices could be placed in appropriate locations and produce power in tune with the primary resonant seismic energy source (Thériault et al. 2014; Uyeshima 2007).

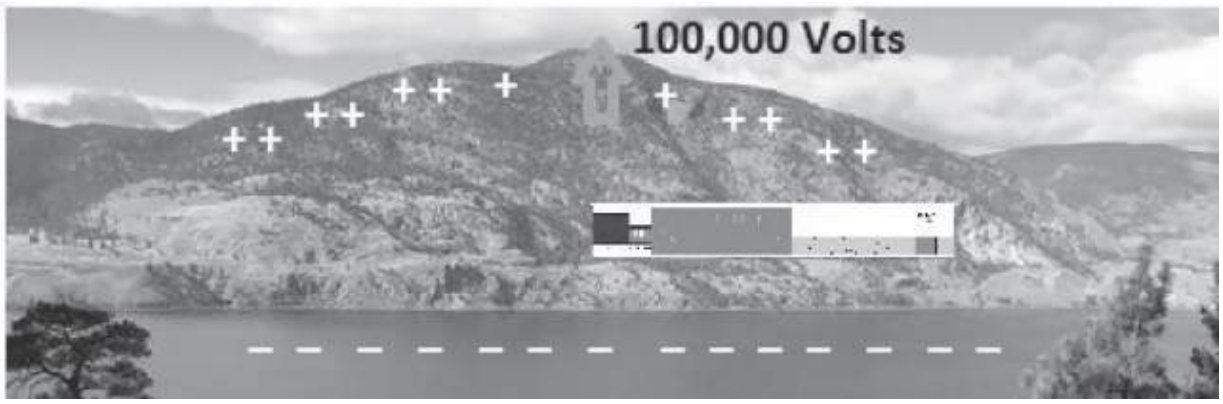

Figure Ac.5. Power is generated by vibration and large-scale ionization.

VI. CONCLUSION

The largest proposed thermoacoustic machines are tuned with the combined length of all chambers approximately 350–400 feet (106.68–121.92 meters) in length for best performance, narrow and long, much like a subway underground station or a bored tunnel. The construction would be best served inside of a mountain.

The power plant using these proven subsystem technologies would benefit when placed in a location of natural rock and structured with acoustic chambers of stone tightly fit without mortar. The best location for this structure would be near a flowing river or the dam discharge flume from a lake or a pond.

Thermoacoustic engines sometimes require a hammer-force shock to start the reaction. The force of a natural water flow can be used in conjunction with the concept of a hydraulic ram pump to supply this force inside the structure and to supply cooling for the reactions inside the structure. The hydraulic ram pump driven on a large scale is capable of producing several tons of shock force. The magnitude of this force would be sufficient to shock the thermoacoustic system into action. Once the hydraulic ram triggers the first vibrational shock to start the system, the reaction will continue until the process is mechanically interrupted.

ACKNOWLEDGMENTS

Special thanks to Friedemann Freund and the NASA GeoCosmo Research Centre.

Eric Wilson: Technical Specialist—Thermal Management, Research and Technology.

ERIC WILSON received an undergraduate degree in Advanced Technical Studies from Southern Illinois University in 1997, combining an aviation, electrical, and mechanical engineering degree.

In 2008, Wilson graduated with a Master of Technology from Purdue University in Lafayette, Indiana.

Currently, Wilson is based in Giza, Egypt as a technical specialist in thermal management, electrical machines, and cyber security for a major

gas turbine engine manufacturer.

Wilson fills his time in Giza by continuing to research ancient technology, and since 2019 has provided volunteer assistance to advance pyramid scanning projects.

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*As presented to the American Institute of Aeronautics and Astronautics (AIAA) 2019 Propulsion and Energy Forum. 19–22 August, 2019, Indianapolis, IN. Edited with permission.

APPENDIX D

THE GREAT PYRAMID OF GIZA AND THE QUEEN'S CHAMBER SHAFTS

A CHEMICAL PERSPECTIVE

BRETT I. COHEN, PHD

ABSTRACT

In his book *The Giza Power Plant: Technologies of Ancient Egypt* (Dunn 1998), Christopher Dunn proposes a very intriguing theory regarding the function of the Queen's Chamber. He suggests that it was an engine of a great power plant, where hydrogen (H_2) gas was used to create piezoelectric or electromagnetic energy. A detailed chemical approach has been applied to the chemicals used in the southern and northern shafts of the Queen's Chamber. In the South Shaft of the Queen's Chamber, sulfuric acid (H_2SO_4) was used, not hydrochloric acid (HCl) as Dunn describes. In the northern shaft of the Queen's Chamber, a salt mixture of ammonium chloride (NH_4Cl) and zinc chloride ($ZnCl_2$) was used. Hydrogen gas could be generated from both the southern and northern shafts using the chemicals described. A mixing of the southern and northern shaft chemicals was not

necessary for the production of H_2 gas. Each system described in this paper could be a stand-alone source of H_2 gas.

INTRODUCTION

The Great Pyramid of Giza is the oldest and largest of the three pyramids on the Giza Plateau (or Necropolis) in Giza, Egypt. Markings inside chambers in the Great Pyramid reference the construction of the pyramid in the Fourth Dynasty of Egyptian Pharaoh Khufu. The Great Pyramid is the oldest of the Seven Wonders of the Ancient World, the only one that remains largely intact. It is also known as the Pyramid of Khufu or the Pyramid of Cheops. It is believed by Egyptologists that the pyramid was built over a ten- to twenty-year period and that construction was concluded in about 2560 BC (Wikipedia 2001).

In *The Giza Power Plant*, Dunn proposes that the Queen's Chamber in the Great Pyramid of Giza was an engine of a great power plant. Here is a brief description of Dunn's theory.

1. Each of the shafts (southern and northern) found in the Queen's Chamber held separate chemicals, the South Shaft containing dilute hydrochloric acid and the North Shaft having hydrated zinc chloride.
2. When these chemicals were mixed together, hydrogen gas was produced.
3. H_2 gas filled the Grand Gallery and travelled up into the King's Chamber, where acoustic energy was converted to piezoelectric energy.

In this paper, each of the shafts (southern and northern) of the Queen's Chamber and their chemicals as Dunn describes are analyzed for chemical validity, and chemical alternatives are also introduced and discussed. Only the chemistry regarding the Queen's Chamber shafts (southern and northern) and its production of hydrogen gas is discussed.

USE OF SULFURIC ACID (NOT HYDROCHLORIC ACID) IN THE SOUTHERN SHAFT OF THE QUEEN'S CHAMBER

It is proposed that sulfuric acid (molecular weight [MW] of 98.08 g/mol) was used in the southern shaft of the Queen's Chamber. H_2SO_4 is a strong, highly corrosive mineral acid and its historical name is oil of vitriol, the archaic name for sulfate (Karpenko and Norris 2002). Dunn describes the use of dilute hydrochloric acid (HCl) in the southern shaft. He also explains that gypsum residue was found in this shaft. Gypsum is a soft sulfate mineral (calcium sulfate dihydrate, $CaSO_4 \cdot 2H_2O$). Dunn states that the limestone (a sedimentary rock composed largely of the mineral calcite, $CaCO_3$) surrounding the shaft would undergo a chemical reaction with HCl to produce gypsum. However, HCl cannot produce a gypsum adduct since no sulfate (SO_4) is found in its formula, therefore H_2SO_4 is the likely acid used. The chemical substitution reaction below illustrates the production of gypsum adduct from H_2SO_4:

$$\underset{\text{(limestone)}}{H_2SO_4 + CaCO_3} \rightarrow \begin{array}{l} CaSO_4 \text{ (gypsum)} \\ + CO_2 \text{ (carbon dioxide)} \\ + H_2O \text{ (water)} \end{array}$$

The source of H_2 found in the southern shaft could be explained by the dissociation of aqueous H_2SO_4. The use of vitriols dates back to antiquity and is recorded in the Sumerians' word lists (dictionaries) written c. 600 BC (Crosland 1962). In these word lists, all types of vitriol are described according to color. The green vitriol is iron(II) sulfate with seven hydrated water molecules ($FeSO_4 \cdot 7H_2O$) (Crosland 1962). In ancient times, green vitriol was called copperas.

A survey of the chemical literature has not found any reference that the ancient Egyptians used H_2SO_4, but here it is shown that they had the technology and resources to produce large quantities of this acid. Sulfuric acid is a strong, highly corrosive acid. The production and storage of H_2SO_4 would have been problematic for the ancient Egyptians.

The most abundant artifact found in Egyptian archaeological sites is ceramic clay pottery. The ancient Egyptians fired marl clay ceramic pottery

at very high temperatures (between 800°C and 1000°C), and these ceramic materials were very hard after firing (McGovern 1997).

The marl clay ceramic pottery usually did not contain any organic materials after firing. Such a ceramic vessel would have been ideal for the production and storage of H_2SO_4 due to its high chemical resistance and strength. The mineral known as green vitriol would have been used for the production of H_2SO_4 (Schröder 1957). The chemical procedure would be to place the solid green vitriol mineral in a marl clay ceramic vessel and heat it to approximately 1000°C for a few hours. The resulting liquid produced, H_2SO_4, would be decanted off and placed in another marl clay ceramic vessel for storage. The resultant solid residue of green vitriol would then be discarded and the process would be repeated numerous times using new green vitriol mineral.

This chemical procedure is called a dry distillation, and such a procedure is found in the chemical literature.

In 1957, a German chemist, Gerald Schröder, reported a dry distillation procedure using green vitriol. Schröder's procedure is as follows. A quantity of 200 grams (0.72 mol) (approximately half a pound) of green vitriol ($FeSO_4 \cdot 7H_20$, MW of 277.85 g/mol) was gradually elevated in temperature to 1000°C over a three-hour period, after which time approximately 8.0 grams of a "strongly acidic liquid, smelling like SO_2" was obtained.

Upon chemical analysis, this resultant liquid had approximately 11% H_2SO_4. (Schröder 1957). (If the reaction had gone to completion, a total of 70.60 grams of H_2SO_4 would have been produced. Here, the percentage yield is 8.0 grams / 70.60 grams × 100% = 11.33%.)

So, in a very simple procedure, 200 grams of starting material (green vitriol) was heated, and this resulted in the production of approximately 8.0 grams (0.082 mol) of H_2SO_4.

The ancient Egyptians would have repeated this process over and over again to produce large quantities of H_2SO_4. They had the means of achieving the required temperatures from the technology of producing marl clay ceramics, and these ceramic vessels would have been ideal for the production and storage of H_2SO_4.

All different shapes and sizes of marl clay ceramic pottery have been found in archaeological sites. Ceramics with large-diameter lower-vase shapes with small-diameter mouth and neck openings have also been found (McGovern 1997).

This shape would have been ideal for the production of H_2SO_4 because it would have reduced exposure to the fumes of sulfur dioxide (SO_2) gas and hydrogen (H_2) gas in the heating process. Sulfur dioxide gas is a toxic gas with a pungent, irritating, and rotten smell. Green vitriol allows the dry distillation process to occur by virtue of the seven hydrated water molecules found in the mineral compound. When the mineral is heated as described, the solution obtained is a water-based solution of H_2SO_4.

It should be noted that modern chemical processes (chemical reactions in aqueous solution, not dry as the one proposed for the ancient Egyptians) for the production of H_2SO_4 are much more efficient than the procedure described above.

The ancient Egyptians would have put more manpower into the "dry distillation" process and, over time, they would have produced significant quantities of H_2SO_4.

USE OF AN AMMONIUM CHLORIDE–ZINC CHLORIDE SOLUTION IN THE NORTHERN SHAFT OF THE QUEEN'S CHAMBER

Dunn also describes the use of a hydrated zinc chloride ($ZnCl_2$) solution in the northern shaft of the Queen's Chamber. $ZnCl_2$ is a very soluble solid in water, and in the solid form it is extremely hygroscopic (it absorbs water very quickly from the surrounding air).

At the very end of the northern shaft, a limestone door with two metal handles was found, one handle appearing to have a white coating on it and surrounding it.

Dunn believes this coating was formed by some type of electroplating process.

If this is true, it is proposed here that a solution of ammonium chloride (NH_4Cl) would also have been needed for the electroplating process to occur without extreme heat. NH_4Cl is a white, crystalline, inorganic salt

compound that is extremely soluble in water. Aqueous solutions of NH_4Cl are mildly acidic (see EQ1).

A form of electroplating (also called galvanization or hot-dip galvanization) exists where a metal (iron, steel, or copper) is placed in a bath of molten zinc (Zn) at a high temperature (approximately 500°C) (Strutzenberger and Faderl 1998).

This process would have been problematic for the ancient Egyptians, so, in order to achieve the electroplating effect that Dunn describes, they needed to use another chemical, NH_4Cl.

A type of electroplating called electrogalvanization exists, where a thin layer of zinc is deposited and bonded to metal (where a controlled thickness of Zn may be applied and deposited) by running a current of electricity through a salt (saline)–zinc solution, and this process can be performed at lower temperatures, such as at room temperature (Chandrasekar and Pushpavanam 2008).

It is proposed here, where multiple simultaneous reactions are occurring at room temperature, that with the use of an electric current from the production of piezoelectric energy from the complete Giza power plant process (see Introduction), a solution of NH_4Cl (salt) and $ZnCl_2$ could achieve the electroplating effect. The reactions are noted in the equations below.

In EQ1, aqueous NH_4Cl results in the dissociation into NH_3 gas and HCl.

In EQ2, aqueous $ZnCl_2$ and HCl results in the production of metallic Zn for the electroplating process, an unstable zinc hydride (ZnH_2) and chlorine (Cl_2) gas.

In EQ3, ZnH_2 results in the production of metallic Zn for the electroplating process and H_2 gas. Aqueous ZnH_2 has been observed to decompose rapidly in acidic solutions (HCl found in EQ1 and EQ2) (Finholt et al. 1947) to metallic Zn (used for the electroplating process) and H_2 at room temperature.

EQ1 NH_4Cl (ammonium chloride) → NH_3 (ammonia gas) + HCl (hydrochloric acid)

EQ2 $2HCl + 4ZnCl_2$ (zinc chloride) → 3Zn (metallic zinc) + ZnH_2 (zinc hydride) + $5Cl_2$ (chlorine gas)

EQ3 ZnH_2 (zinc hydride) → Zn (metallic zinc) + H_2 (hydrogen gas)

Some of the gasses produced in EQ1, EQ2, and EQ3 (NH_3, Cl_2, and H_2) could be dissolved in the aqueous salt (saline) solution of NH_4Cl and $ZnCl_2$. The formation of H_2 gas in EQ3 is a source of H_2 gas found in the northern shaft. Sal ammoniac is the name of the natural mineralogical form of NH_4Cl, and the mineral is commonly found on burning coal dumps (due to the condensation of coal-derived gas). Interestingly, the word "ammonia" (NH_3) is related to the classical-era discovery of sal ammoniac near the temple of Zeus Ammon in the Siwa Oasis in the Libyan Desert.

The ancient Egyptians were very familiar with NH_4Cl. At one stage in their history, they worshipped Amun (or Amon, a major Egyptian deity) and used NH_4Cl in their religious worship rituals. Also, several words are derived from Amun via the Greek form, Ammon, such as "ammonia" and "ammonite" (Sutton et al. 2008).

CONCLUSION

In conclusion, it is proposed that in the southern shaft of the Queen's Chamber, H_2SO_4 was the acid used, not HCl. In the northern shaft of the Queen's Chamber, a salt (saline) mixture of NH_4Cl and $ZnCl_2$ was used. It has been illustrated that H_2 gas could be generated from both the southern (H_2SO_4) and northern (NH_4Cl–$ZnCl_2$) shafts using the chemicals described in this paper.

It would not be feasible for the mixing of the chemicals of the southern and northern shafts to be efficient, since Dunn describes no mixing apparatus as existing in the Queen's Chamber.

Therefore, it is also proposed that a mixing of chemicals of the southern and northern shafts was not necessary for the production of H2 gas. Each system described in this paper could be a stand-alone source of H2 gas.

BRETT I. COHEN holds a PhD in inorganic and bioinorganic chemistry from the State University of New York at Albany. He received his PhD in November 1987 for his thesis titled "Chemical Model Systems for Dioxygen-Activating Copper Proteins" and was a postdoctoral fellow at Rutgers University in 1988–1989.

His research at Rutgers was in the area of peptide synthesis utilizing transition metal chemistry. After his postdoctoral fellowship, from 1989 to 2003, Cohen was one of the owners of Essential Dental Systems (manufacturer of dental composites and dental materials), where he was chief executive officer and vice president of dental research.

Cohen has had over 100 papers published in peer-reviewed journals (such as *Journal of the American Chemical Society*, *Inorganic Chemistry*, *Journal of Dental Research*, *Journal of Prosthetic Dentistry*, *Journal of Endodontics and Autism*, etc.) and has obtained 16 US patents.

His papers cover a variety of areas such as inorganic and bioinorganic chemistry, biomedicine, autism, physical chemistry, dentistry, and more. Cohen can be reached via email at ebicbis@aol.com.

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BIBLIOGRAPHY

Academo. n.d. “Wave Interference and Beat Frequency.” Academo website.

Adly, Ahmed. 2021. “Measures of the Box in Serapeum.” Ahmed Adly YouTube channel, February 28, 2020. Accessed April 29, 2022.

Aizawa, K. “A Large Self-Potential Anomaly and Its Changes on the Quiet Mt. Fuji, Japan.” *Geophysical Research Letters* 31, L05612 (2004).

Alexander, D., M. T. Migliorino, S. Heister, C. Scalo. “Numerical and Experimental Analysis of a Transcritical Thermoacoustic Prototype.” Paper presented at the AIAA Fluid Dynamics Conference, Atlanta, Georgia, 2018.

Allen, C. “The Role of Animal Behavior in the Chinese Earthquake Prediction Program.” In *Abnormal Animal Behavior Prior to Earthquakes*, J.F. Evernden (ed.), National Earthquake Hazards Reduction Program, USGS, Menlo Park, CA, 23–24 September 1976, 5–13.

Babbage, Charles, Philip Morrison, and Emily Morrison. 2012. *Charles Babbage*: *On the Principles and Development of the Calculator and Other Seminal Writings.* Mineola, NY: Dover Publications.

Balezin, Mikhail, Kseniia V. Baryshnikova, Polina Kapitanova, and Andrey B. Evlyukhin. “Electromagnetic Properties of the Great Pyramid: First Multipole Resonances and Energy Concentration.” *Journal of Applied Physics*, 124, 034903 (2018).

Barsanti, Alessandro. 1906. “Fouilles de Zaouiét el-Aryán (1904–1905).” *Annales du service des antiquités de l’Égypte—Súppleménts (ASAE)*, 7: 257–287. Institut Français d’Archéologie Orientale, Kairo.

BrainyQuote website. n.d. “Arthur C. Clarke Quotes.” Accessed April 9, 2022.

Bressan, David. 2020. “Nikola Tesla’s Earthquake Machine.” *Forbes* online, January 7, 2020..

Brown, David Jay, and Rupert Sheldrake. n.d. “Unusual Animal Behavior Prior to Earthquakes: A Survey in North-West California.” Animals and Earthquakes Survey website. Accessed April 18, 2022.

Cayce, Edgar Evans, Gail Cayce Schwartzer, and Douglas G. Richards. 1998. *Mysteries of Atlantis Revisited*. New York: Harper Collins.

Chandrasekar, M. S. and M. Pushpavanam. 2008. “Pulse and Pulse Reverse Plating—Conceptual, Advantages and Applications.” *Electrochimica Acta* 53 (8): 3313–3322.

Clarke, Arthur C. 1964. *Profiles of the Future: An Inquiry into the Limits of the Possible*. New York: Bantam Books. First published 1962.

———. 1968. “Clarke’s Third Law on UFOs.” *Science* 159 (3812) (1968-01-19): 255.

Clow, Barbara Hand. 2011. *Awakening the Planetary Mind.* Rochester, VT: Bear & Company.Cohen, Ariel. 2019. “Is Fusion Power within Our Grasp?” *Forbes* website, January 14, 2019.

Cohen, Brett. 2015. “The Great Pyramid of Giza and the Queen’s Chamber Shafts: A Chemical Perspective.” *Nexus* (August–September 2015): 43–46.

Crosland, M. P. 1962. *Historical Studies in the Language of Chemistry*. London: Heinemann.

Daniels, Jeff. 2017. “Mini-Nukes and Mosquito-Like Robot Weapons Being Primed for Future Warfare.” CNBC website, March 17, 2017.
Danley, Thomas. 2000. “The Great Pyramid: Early Reflections & Ancient Echoes.” *Live Sound International,* July/August 2000. Reprinted August 4, 2020, at ProSoundWeb Website. Accessed April 28, 2022.
de Bourrienne, Louis Antoine Fauvelet. 1831. *Private Memoirs of Napoleon Bonaparte, During the Periods of the Directory, the Consulate, and the Empire, Vol. I.* New York: Nabu Press.
Descartes, René. 2008. *Meditations on the First Philosophy: With Selection from the Objections and Replies*. Translated by Michael Moriarty. New York: Oxford University Press.
Drexler, K. Eric. 1987. *Engines of Creation: The Coming Era of Nanotechnology.* New York: Anchor Books. (Originally published in hardcover on January 1, 1986).
Dunn, Christopher. 1984. “Advanced Machining in Ancient Egypt?” *Analog Science Fiction and Fact*, August 1984.
———. 1998. *The Giza Power Plant: Technologies of Ancient Egypt*. Rochester, VT: Bear & Company.
———. 2010. *Lost Technologies of Ancient Egypt: Advanced Engineering in the Temples of the Pharaohs*. Rochester, VT: Bear & Company.
Edwards, I. E. S. 1993. *The Pyramids of Egypt*. London: Penguin Books Ltd.
Effat, Mahmoud, Fathi Saleh, and Robert Gribbs. 2000. “On the Discovery of the Ancient Egyptian Musical Scale.” EgyptSound.fr website. Accessed April 28, 2022.
El-Aref, Nevine. 2017. “Void within Great Pyramid Of Giza ‘not a new discovery’: Zahi Hawass” Ahram Online website, November 2, 2017.
Elfouly, Gamal. 2012. *The Great Pyramid System: The Blue Light*. CreateSpace Independent Publishing.
Ellis, Ralph and Mark Foster. 2000. “The Enigma of Mamun’s Tunnel.” *Atlantis Rising* 25, 2000.
Energy Market Authority. n.d. “Singapore Energy Statistics, Chapter 2: Energy Transformation.” Energy Market Authority website.
Fakhry, Ahmed. 1969. *The Pyramids*. Chicago: University of Chicago Press.
Finholt, A. E., A. C. Bond Jr., and H. I. Schlesinger. 1947. “Lithium Aluminum Hydride, Aluminum Hydride and Lithium Gallium Hydride, and Some of their Applications in Organic and Inorganic Chemistry.” *J. American Chemical Society* 69 (5): 1199–1203.
Florinsky, Igor V. 2016. “Earthquake Lights in Legends of the Greek Orthodoxy.” *Mediterranean Archaeology and Archaeometry* Vol. 16, no. 1 (January 2016): 159–168.
Freund, Friedemann. 2000. “Time-Resolved Study of Charge Generation and Propagation in Igneous Rocks.” *Journal of Geophysical Research* 105, no. B5 (May 10, 2000): 11001–11019.
———. 2003. “Rocks That Crackle and Sparkle and Glow: Strange Pre-Earthquake Phenomena.” *Journal of Scientific Exploration* Vol. 17, no. 1 (2003): 37–71.
———. 2009. “Pre-Earthquake Signals Introduction to Basic Solid State Processes.” *Contemporary Physics* (August 10, 2009): 36.
———. 2013. “Nature of Pre-Earthquake Phenomena and Their Effects on Living Organisms.” *National Library of Medicine: Center for Biotechnology Information*. Published online 2013 Jun 6.
———. 2014. “Rocks that Crackle and Glow: Predicting Earthquakes.” Filmed at the 33rd Annual Conference of the Society for Scientific Exploration, June 6–7, 2014, San Francisco, California. Society for Scientific Exploration YouTube channel. November 21, 2019.
———. 2016. “Using Semiconductor Physics to Forecast Earthquakes.” TEDx talk, Christchurch, New Zealand, December 12, 2016. TedX Talks YouTube Channel. Accessed April 13, 2022.
Freund, Friedemann, G. Ouillon, J. Scoville, and D. Sornette. 2021. “Earthquake Precursors in the Light of Peroxy Defects Theory: Critical Review of Systematic Observations.” *European Physical Journal* (2021). Special Topics 230, 7–46 (2021).

Freund, F., V. Stolc. 2013. “Nature of Pre-Earthquake Phenomena and their Effects on Living Organisms.” *Animals (Basel)* 3, no. 2 (June 6, 2013): 513–31.
Ghoneim, M. Zakaria. 1956. *The Lost Pyramid*. New York: Rinehart & Company.
Gough, Evan. 2022. “Archeologists To Scan The Great Pyramid Of Giza With Cosmic Rays.” Universe Today website. February 28, 2022. Accessed May 8, 2023
Hawass, Zahi. 2014. “The So-Called Secret Doors Inside Khufu’s Pyramid.” *Ministry of Antiquities* published in *CASAE* 43 (2014): 51–68.
Hays, W. W. (ed.). 1981. *Facing Geologic and Hydrologic Hazards—Earth Science Considerations*. US Geological Survey, Professional Paper 1240-B.
History’s Mysteries. 1995. “Secrets of the Pyramids and the Sphinx.” Maximum Truthseeker YouTube Channel. Accessed April 11, 2022.
Hooper, Rowan. 2011. “First Images from Great Pyramid’s Chamber of Secrets.” New Scientist website. May 25, 2011. Accessed April 27, 2022.
HyperPhysics. n.d. “Reflection of Sound.” HyperPhysics website.
Karpenko, V. and J.A. Norris. 2002. “Vitriol in the History of Chemistry.” *Chemické Listy* 96 (2002): 997–1005.
Kato, Mamoru. 2007. “Why Light Flashes—Light Emissions before and during Earthquakes: Presenting the Witnesses and Scientific Experiments.” Paper presented to a conference held at the Earthquake and Volcano Research Center, Graduate School of Environmental Studies, Nagoya University, Japan, January 26, 2007.
Kingsland, William. 1996. *Great Pyramid in Fact and Fiction.* Kessinger Publishing, LLC. Facsimile edition, April 1, 1996.
Kunkel, Edward J. 1962. *The Pharaoh’s Pump*. Self-published. Reprints from Peg’s Print Shop; rev. and enlarged edition, January 1, 1973.
Lee, W. H. K., M. Ando, and W. H. Kautz. 1976. “A Summary of the Literature on Unusual Animal Behavior Before Earthquakes.” In *Abnormal Animal Behavior Prior to Earthquakes,* J.F. Evernden (ed.), National Earthquake Hazards Reduction Program, USGS, Menlo Park, CA, 23–24 September 1976, 15–54.
Lehner, Mark. 1997. *The Complete Pyramids. Solving the Ancient Mysteries*. London: Thames & Hudson.
Lehner, Mark and Zahi Hawass. 2017. *Giza and the Pyramids: The Definitive History*. Chicago: University of Chicago Press.
Maragioglio, Vito and Celeste Rinaldi. 1965. *L’architettura delle piramidi Menfite*. *Parte IV (2 vols).* English transl. by J. A. Zanini Jellis and V. Maragioglio. Tavole. Rapallo: Tipografia Canessa: Rapallo, 1965.
McGovern, P. E. 1997. “Wine of Egypt’s Golden Age: An Archaeochemical Perspective.” *J. Egyptian Archaeology* 83 (1997): 69–108.
Morishima, Kunihiro, Mitsuaki Kuno, and Mehdi Tayoubi. 2017. “Discovery of a Big Void in Khufu’s Pyramid by Observation of Cosmic-Ray Muons.” *Nature.* 552 (November 2, 2017): 386–390.
National Geographic. 2002. “Into The Great Pyramid.” The Last Pyramid Builder YouTube Channel. February 23, 2020. Accessed April 11, 2022.
New Madrid. n.d. “Strange Happenings during the Earthquakes.” New Madrid, Missouri website. Accessed June 24, 2022.
Noone, Richard W. 1986. *5/5/2000: Ice: The Ultimate Disaster*. New York. Harmony Books.
ODNI. 2021. *Preliminary Assessment: Unidentified Aerial Phenomena.* Office of the Director of National Intelligence website. June 25, 2021. Accessed 2/17/2022.
Pacific Coastal and Marine Science Center. 2018. “Tsunami Generation from the 2004 M=9.1 Sumatra-Andaman Earthquake.” US Geological Survey website. October 8, 2018. Accessed April 11, 2022.

Petrie, William Flinders. 1883. *Pyramids and Temples of Gizeh*. London, England: Field & Tuer. Reprinted 1990. London, England: Histories and Mysteries of Man.
Piroddi, L., G. Ranieri, F. Freund, and A. Trogu. "Geology, Tectonics and Topography Underlined by L'Aquila Earthquake TIR Precursors." *Geophysics Journal International* 197 (2014): 1532–1536.
Pond, Dale and Walter Baumgartner. 1995. *Nikola Tesla's Earthquake Machine*. Santa Fe, NM: The Message Company.
Qvist, Mark. 2023. "Abstractions Set In Granite." March 18, 2023. Unsigned.Io Website. Accessed July 6, 2023.
Roadside America website. n.d. "Cursed Pyramid Ruins." Accessed June 24, 2022.
Rubinstein, William D. 2008. *Shadow Pasts: History's Mysteries*. Harlow, UK: Pearson Education Limited.
Sagan, Carl. 1996. *The Demon-Haunted World: Science as a Candle in the Dark*. New York: Ballantine Books.
Schoch, Robert M. 1992. "How Old is the Sphinx?" Abstracts for the Annual Meeting of the American Association for the Advancement of Science, Chicago (1992): 202.
Schoch, Robert M. 2010. "The Mystery of Göbekli Tepe and Its Message to Us." New Dawn Magazine 122 (Sept–Oct 2010).
Schoch, Robert. 2018. "The Big Void." *Atlantis Rising* 128 (June–September, 2018).
ScoopEmpire. 2017. "Meet Aliaa Ismail, Egypt's First Female Egyptologist." November 11, 2017. Scoop Empire Website. Accessed May 23, 2022.
Schröder, G. 1957. "Die pharmazeutisch-chemischen Produkte deutscher Apotheken im Zeitalter der Chemiatrie." Technischen Hochschule Braunschweig, Bremen (1957): 61.
Selin, Shannon. 2017. "Napoleon at the Pyramids: Myth Versus Fact." Shannon Selin website.
Seyzfadeh, Manu, 2021. *Under the Sphinx: the Search for the Hieroglyphic Key to the Real Hall of Records.* Englewood, CO. Hugo House Publishers.
Sibson, Matt. 2020. "The Robot, The Dentist and the Pyramid: Ancient Egypt Documentary (2020)." Ancient Architects YouTube channel, February 19, 2020. Last accessed April 27, 2022.
Sibson, Matt. 2021. "First Look Inside the Great Pyramid Queen's Chamber Northern Shaft." Ancient Architects YouTube channel, July 28, 2021. Last accessed April 26, 2022.
Smyth, Charles Piazzi. 1978. *The Great Pyramid: Its Secrets and Mysteries Revealed*. New York, NY. Bell Publishing Company. Originally published in 1880 as *Our Inheritance in the Great Pyramid*.
Strutzenberger, J. and J. Faderl. 1998. "Solidification and Spangle Formation of Hot-Dip-Galvanized Zinc Coatings." *Metallurgical and Materials Transactions* A 29 (February 1998): 631–646.
Sutton, M. A., J. W. Erisman, F. Dentener, and D. Möller. 2008. "Ammonia in the Environment: From Ancient Times to the Present." *Environmental Pollution* 156 (2008): 583–604.
Takeuchi, Akihiro, O'mer Aydan, Keizo Sayanagi, and Toshiyasu Nagao. 2011. "Generation of Electromotive Force Due to Non-Uniform Compression of Igneous Rock and its Mechanism." Tokai University Marine Research Institute Research, Report No. 32 (2011): 45–51.
Taylor, John. (1859) 2014. *The Great Pyramid: Why Was It Built? And Who Built It?* Cambridge, UK: Cambridge University Press.
The Engineering Toolbox website. 2022. "Solids and Metals—Speed of Sound." Accessed May 25, 2022.
Tesla, Nikola and the Secret Libraries. 2016. *Nikola Tesla Quotes . . . Vol.3: Motivational & Inspirational Life Quotes by Nikola Tesla*. CreateSpace Independent Publishing Platform.
Thériault, R., F. St-Laurent, F. Freund, and J. S. Derr. "Prevalence of Earthquake Lights Associated with Rift Environments." *Seismological Research Letters* (January 2014).
Tompkins, Peter. 1971. *Secrets of the Great Pyramid*. New York: Harper & Row.
Tributsch, H. 1982. *When the Snakes Awake*. Cambridge: MIT Press.

US Energy Information Administration. n.d. “What is U.S. Electricity Generation by Energy Source?” US Energy Information Administration website. Accessed March 4, 2022.
Uyeshima, M. (2007). “EM Monitoring of Crustal Processes Including the Use of the Network-MT Observations.” *Surveys in Geophysics* (May 2007).
Vitruvius. 1914. *The Ten Books on Architecture*. Translated by Morris Hicky Morgan and Albert A. Howard. Cambridge, MA: Harvard University Press.
White, George S. (1836) 2012. *Memoir of Samuel Slater: The Father of American Manufacturers*. London: Forgotten Books.
Wikipedia. 2011. “Electricity Sector in the United Kingdom.” Accessed April 11, 2022. Last edited April 6, 2022.
Wikipedia. 2022. “2009 L’Aquila earthquake.” Accessed April 11, 2022. Last edited March 16, 2022.
Zeigarnik, Vladimir and Victor Novikov. 2014. “Electromagnetic Earthquake Triggering Phenomena: State-of-the-Art Research and Future Developments.” Geophysical Research Abstracts Vol. 16, EGU2014-16221, EGU General Assembly 2014, held April 27–May 2, 2014, in Vienna, Austria.

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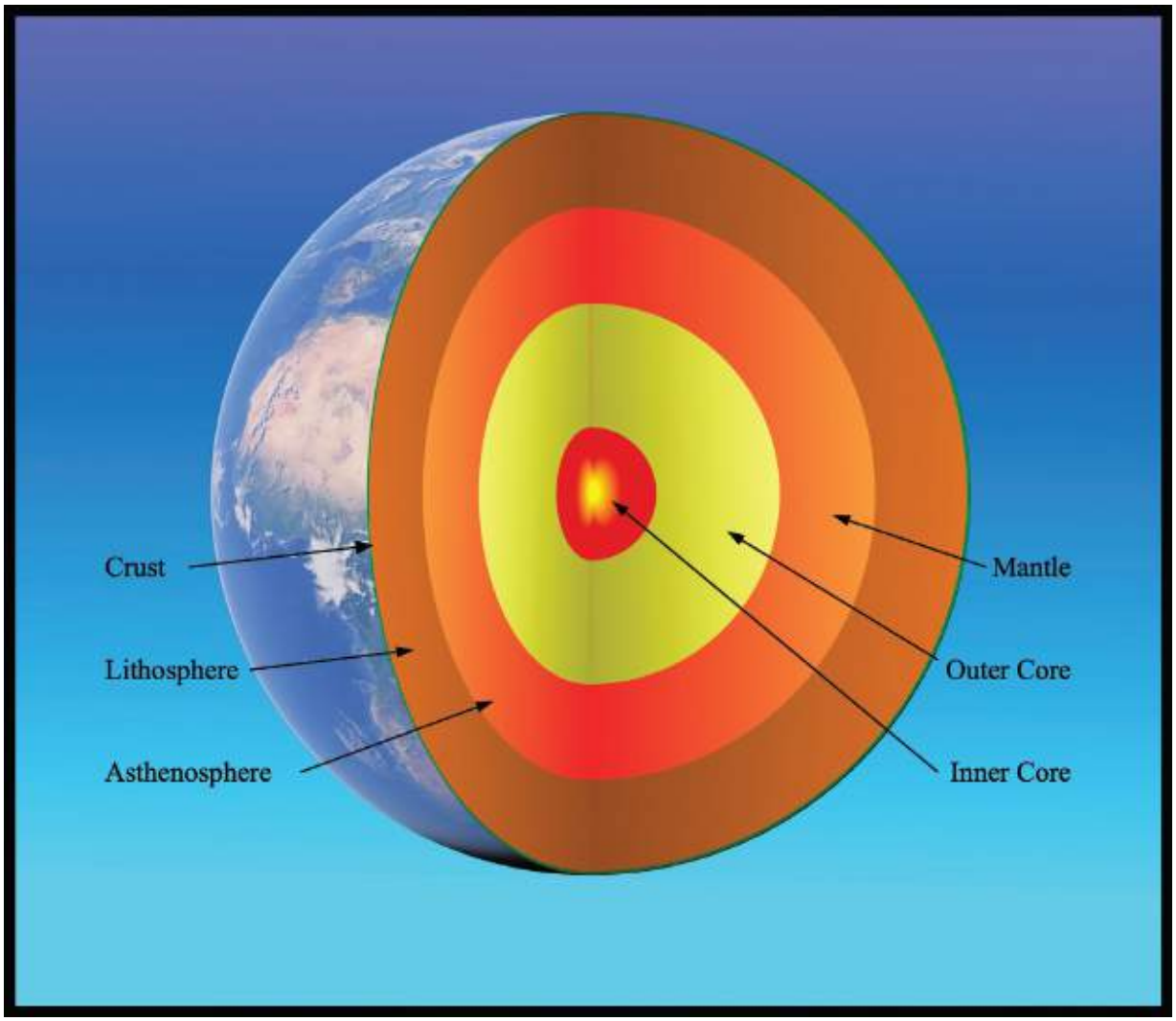

Plate 1. *The layers of planet Earth. Earthquakes occur when the tectonic plates that make up the Earth's crust shift with the motion of the mantle. NASA physicist Friedemann Freund, PhD, developed a theory to explain the atmospheric phenomenon of earthquake lights —an electrical anomaly occurring in the Earth before and during earthquakes. Certain types of igneous rocks found in Earth's mantle and crust contain dormant electronic charge carriers. Freund's fundamental discovery found that when stressed, such as under earthquake conditions, these rocks hold an electric charge and essentially turn into a battery. Freund's theory was tested in laboratory conditions by himself and others and proven to be correct.*

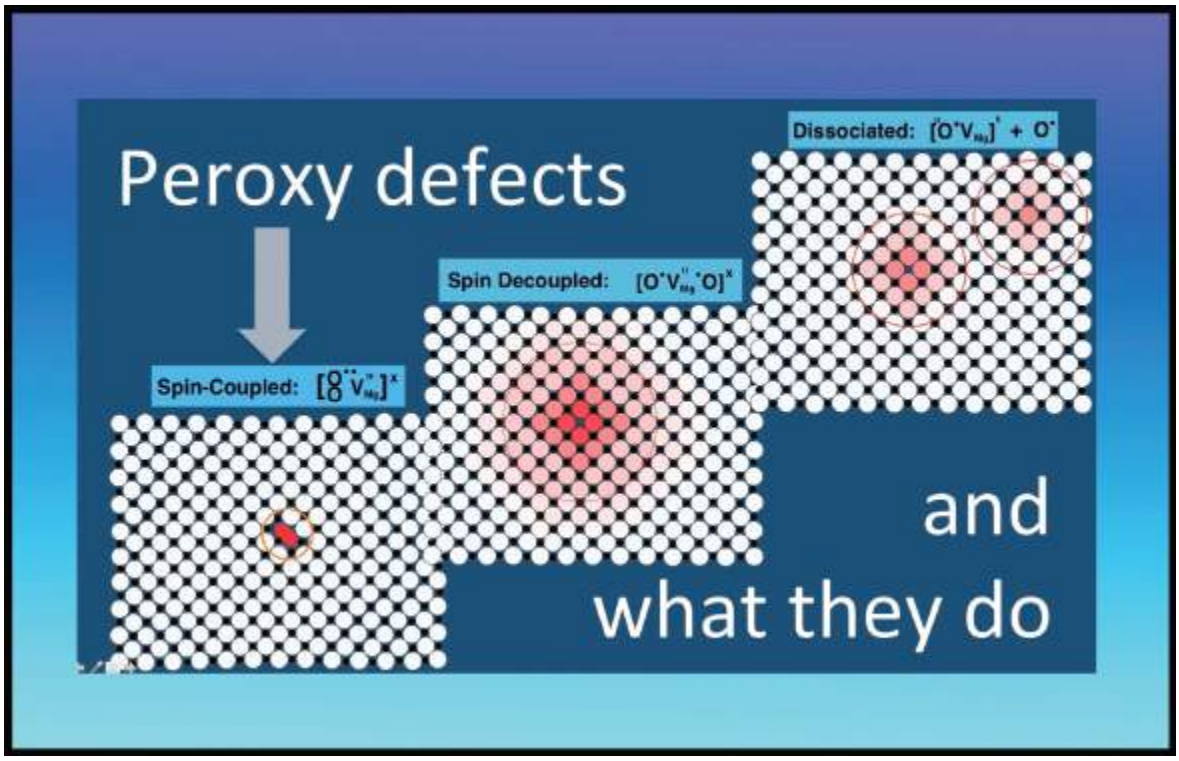

Plate 2. *Freund's illustration of the physics behind earthquake lights. Image credit: F. Freund (see Appendix B).*

Plate 3. *Freund's Laboratory at NASA where he successfully tested his theory.*
Image credit: F. Freund (see Appendix B).

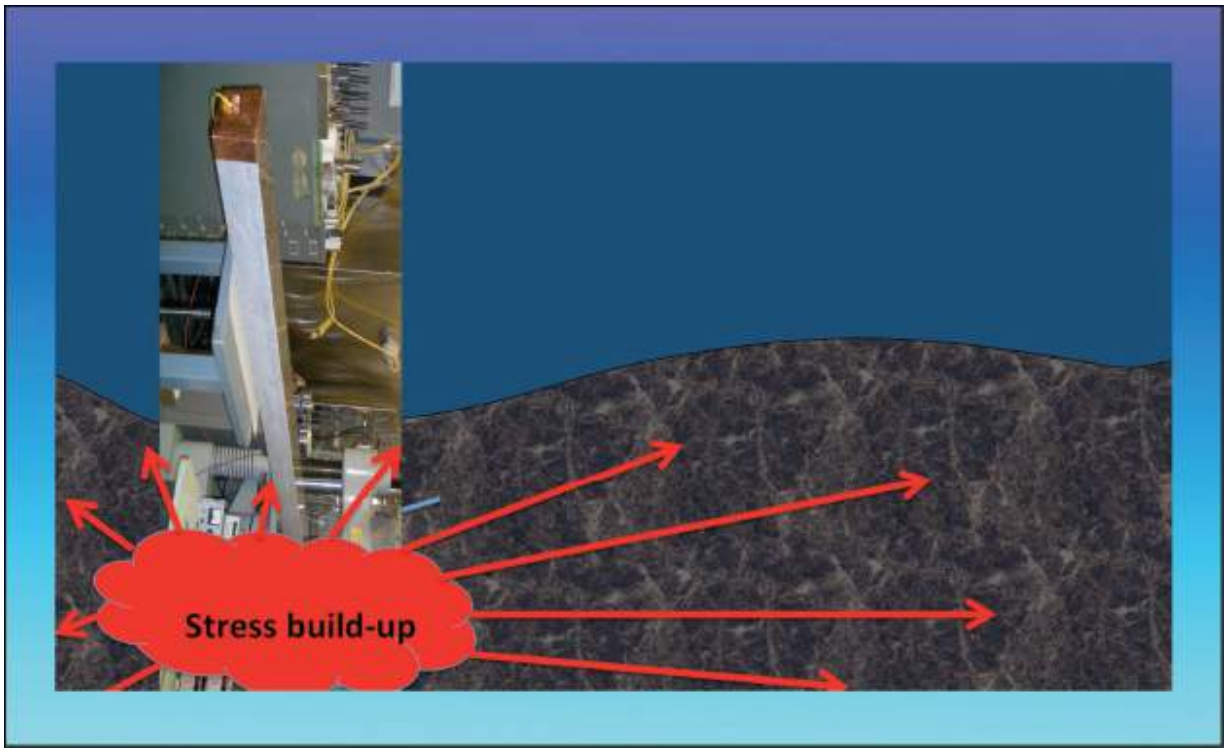

Plate 4. *Freund's granite shown vertically to illustrate the same orientation at which igneous rock in the Earth is squeezed prior to and during an earthquake.*
Image credit: F. Freund (see Appendix B).

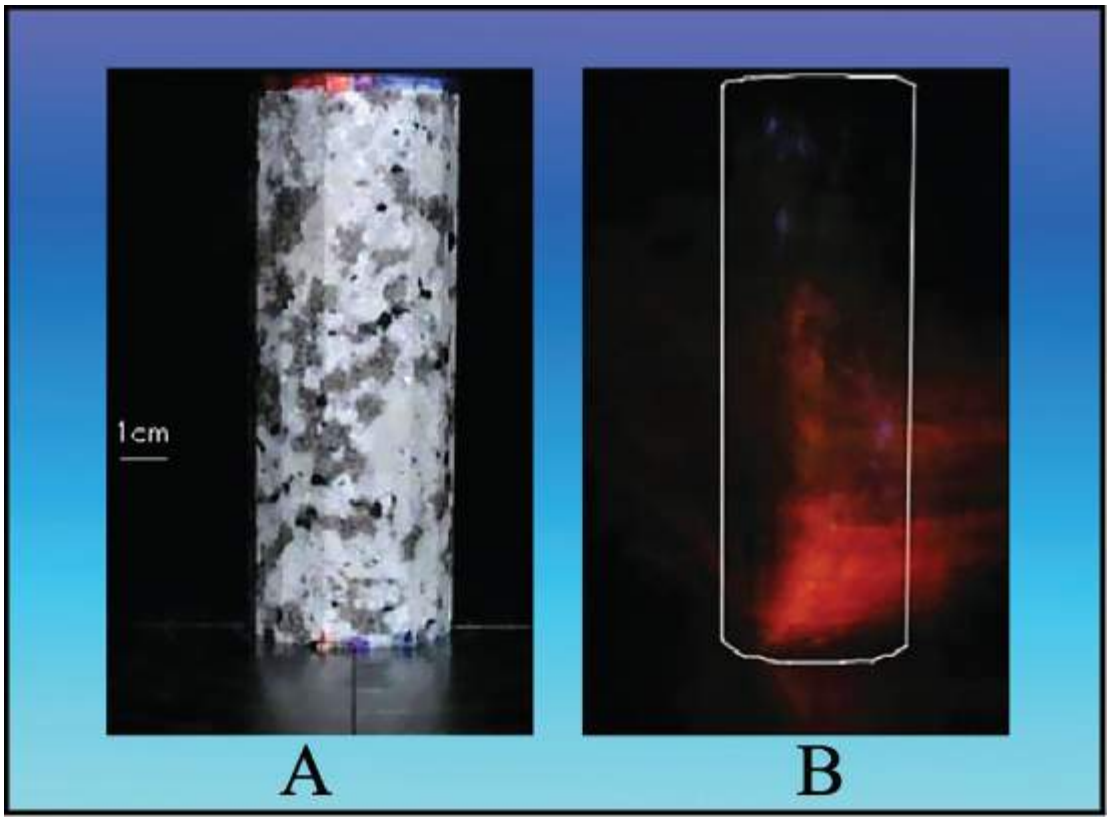

Plate 5. *Photographs of granite under stress. A: Lights on; normal digital camera. B: Lights turned off; infrared camera. It has been speculated that airflow in the room, flowing left to right, caused the ions cloud to extend outside the granite.*
Image credit: F. Freund after M. Kato (see Appendix B).

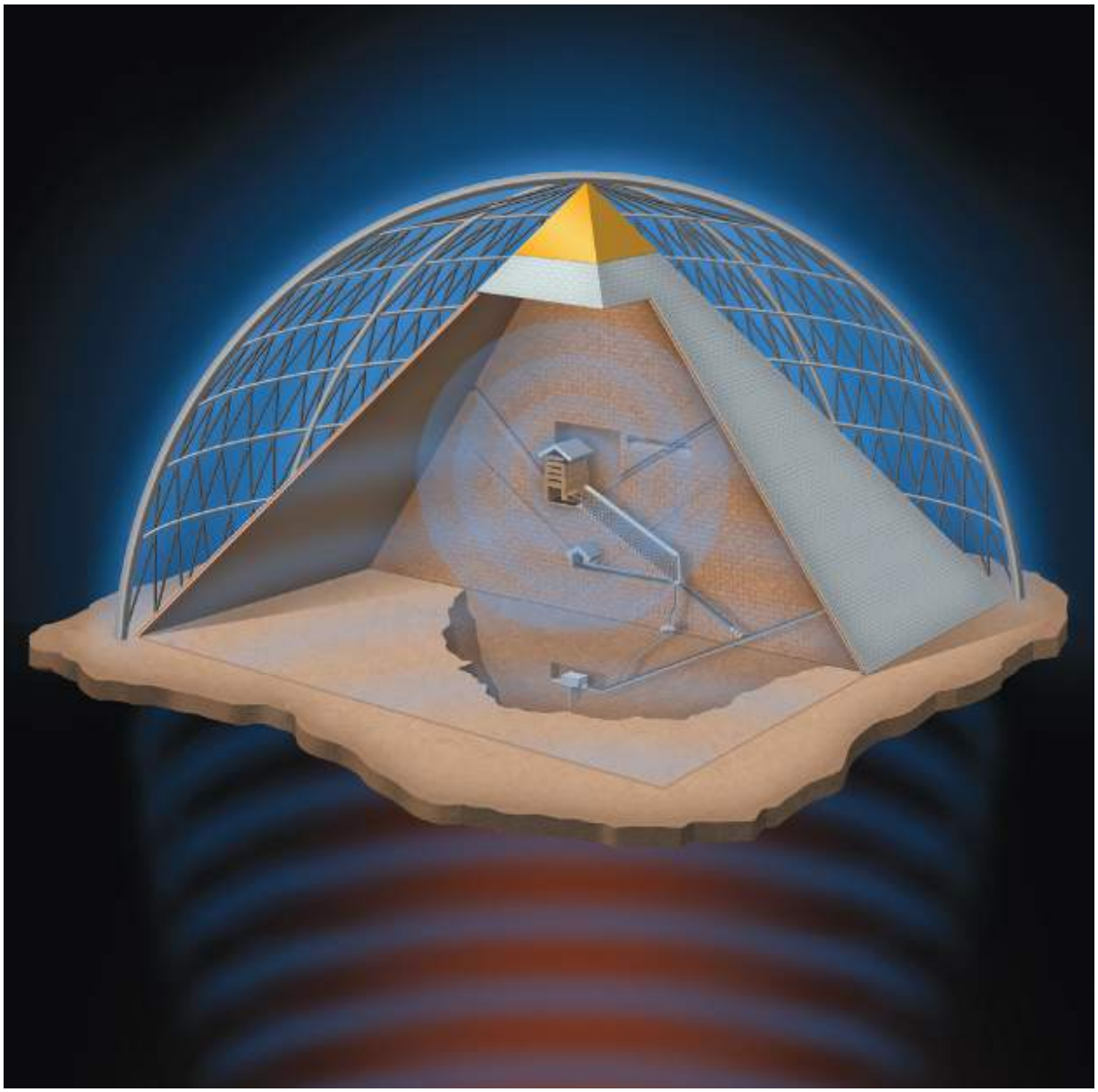

Plate 6. *Fulfilling the need to create a circuit, perhaps a dome could serve to radiate power into the atmosphere, as proposed by Nikola Tesla in his vision for the wireless distribution of electricity (Wardenclyffe Tower Project).*

Plate 7. *Electron harvesters at Giza, Egypt. Electrons that are stimulated to flow out of the lithosphere will seek the highest point on the local topography. With the Giza Plateau serving as a pulse generator to cause vibrations in the lithosphere, the pyramids attract and focus the electrons that are squeezed out of igneous rock below.*

Plate 8. *The Pyramids of Giza: Manmade mountains of stone designed to attract electrons that are squeezed out of igneous rock within the Earth's crust.*

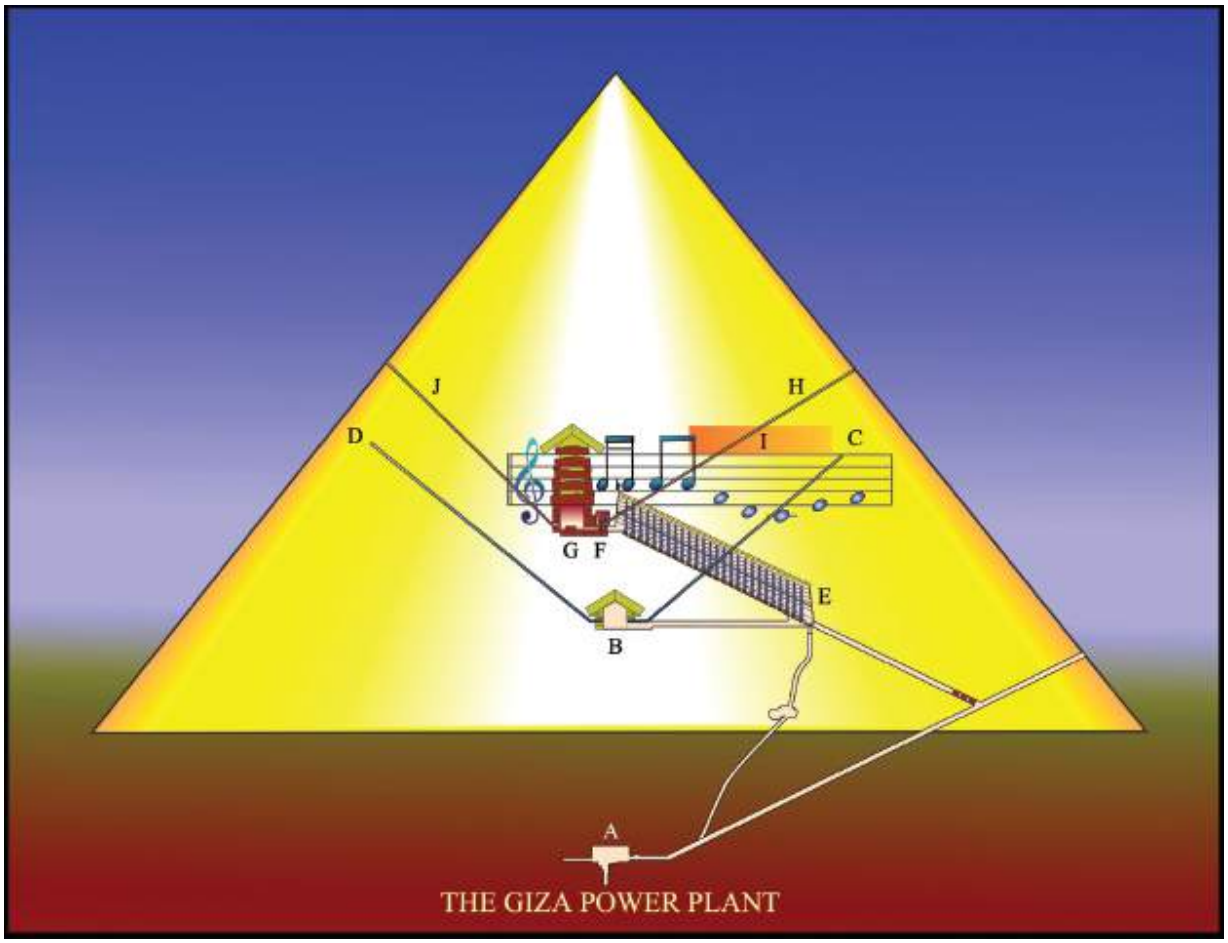

Plate 9. *The schematics of a solid-state power plant.*
A: Pulse generator [aka Queen's Chamber]
B: Hydrogen production chamber [aka Subterranean Chamber]
C: Chemical inlet conduit (hydrated zinc) [aka Queen's Chamber North Shaft]
D: Chemical inlet conduit (dilute hydrochloric acid) [aka Queen's Chamber South Shaft]
E: Acoustic amplifier [aka Grand Gallery]
F: Acoustic filter? [aka Antechamber]
G: Resonant Cavity [aka King's Chamber]
H: Waveguide [aka King's Chamber North Shaft]
I: Microwave preamplifier [aka The Big Void]
J: Power output shaft [aka King's Chamber South Shaft]

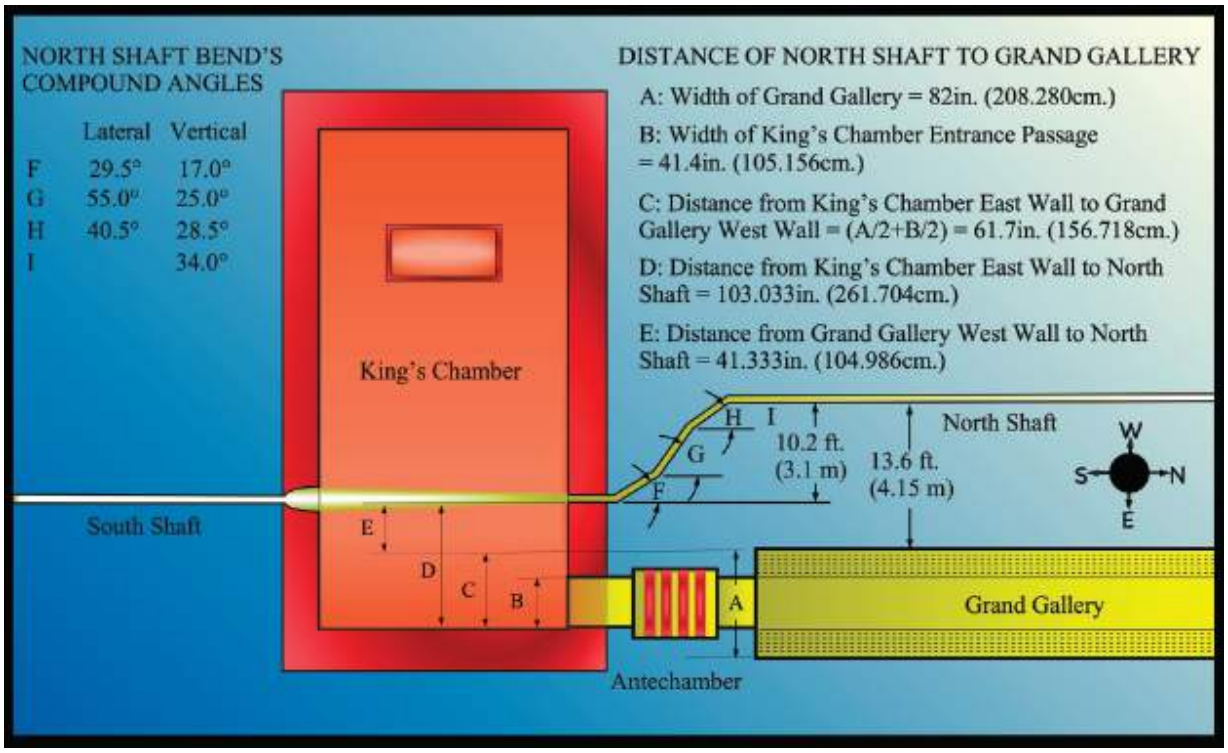
NORTH SHAFT BEND'S COMPOUND ANGLES
Lateral Vertical
F 29.5° 17.0°
G 55.0° 25.0°
H 40.5° 28.5°
I 34.0°
DISTANCE OF NORTH SHAFT TO GRAND GALLERY
A: Width of Grand Gallery = 82in. (208.280cm.)
B: Width of King's Chamber Entrance Passage = 41.4in. (105.156cm.)
C: Distance from King's Chamber East Wall to Grand Gallery West Wall = (A/2+B/2) = 61.7in. (156.718cm.)
D: Distance from King's Chamber East Wall to North Shaft = 103.033in. (261.704cm.)
E: Distance from Grand Gallery West Wall to North Shaft = 41.333in. (104.986cm.)
King's Chamber
South Shaft
North Shaft
10.2 ft. (3.1 m)
13.6 ft. (4.15 m)
Grand Gallery
Antechamber
W
S
N
E

Plate 10. *Top view of power center. Drawing by C. Dunn after R. Gantenbrink with dimensions from Gantenbrink (angles) and Petrie (lengths). The significance of the North Shaft, with its multiple compound angle bends cannot be overstated. Before it was fully explored, these inexplicable features in the Great Pyramid were generally thought to be air-shafts. Learning more about them has prompted some to awkwardly suggest they were/are "star shafts" or more esoterically "soul shafts" through which the King's soul was directed towards the heavens. Unfortunately, none of these theories can explain the complications designed into the shafts. Nor do these theories explain why the shafts could not merely run straight to the outer surface. Is it possible that the Grand Gallery wall blocks are almost 13 feet (4m) thick? There is no other way to interpret this evidence other than it exists to serve a much higher purpose.*

The component parts are:

- *Grand Gallery (Acoustic Amplifier)*
- *Antechamber (Acoustic Filter or a Thermo Acoustic engine stack, as proposed by Eric Wilson [see Appendix C])*
- *Kings Chamber (Resonant Cavity)*

- *North Shaft (Microwave signal input)*
- *South Shaft (Power output)*

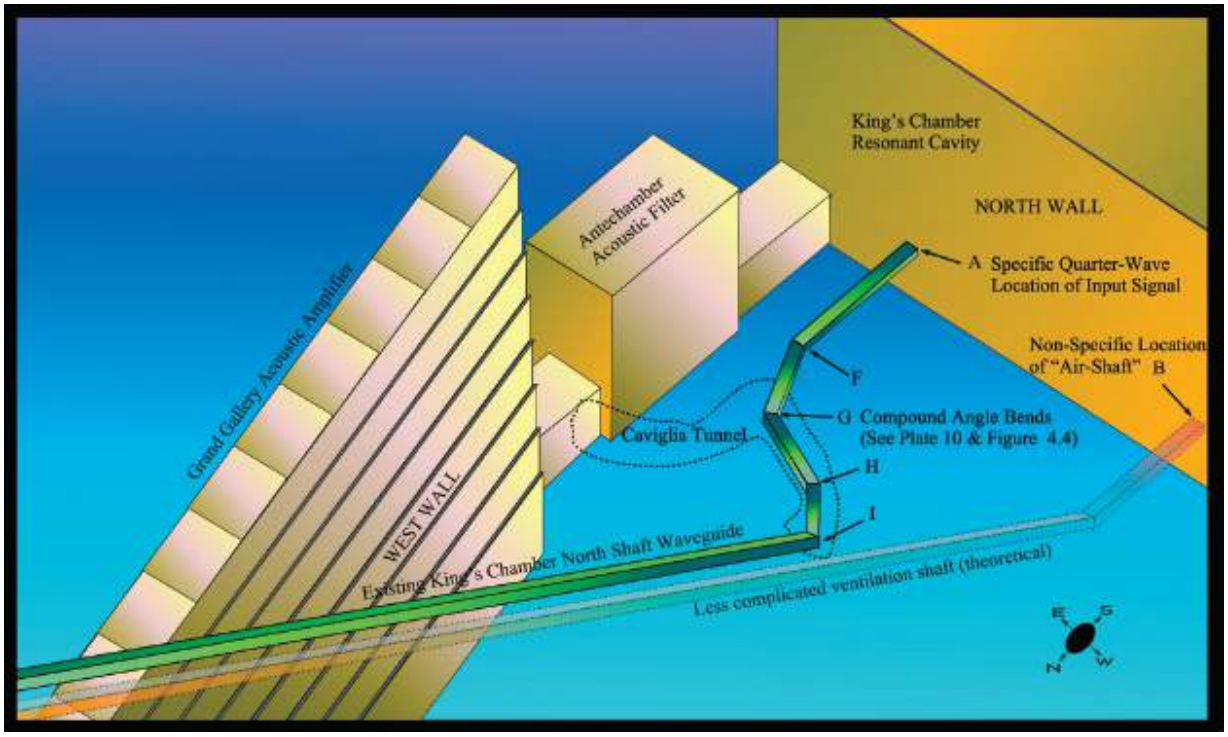

Plate 11. *Mechanical complications that are designed into a product are engineered according to required outcomes. For instance, the more features a mechanical timepiece has, the more complicated its design and manufacture becomes. While the King's Chamber and Queen's Chamber shafts have been described as "airshafts" "star shafts" or "soul-shafts" for the King to use to exit the pyramid tomb and travel beyond, the evidence argues strongly against these theories. Shaft A could be directed to the outside passing the Grand Gallery at a distance of 41.3 inches (104. 986cm) with just one bend. But it has four. Complicated. Why? Shaft B is a theoretical air shaft that only has one bend.*

Solution: Fingerprints of an ancient waveguide.

Waveguide enters the Resonant Cavity at the quarter-wave point where a standing wave in a resonant cavity has the highest amplitude. Similar to modern waveguide design, multiple bends are used. The Waveguide passes the Antechamber Acoustic Filter and

Grand Gallery. See Chapter Four and Plate 10. Drawing by C. Dunn based on R. Gantenbrink's wire-frame CAD drawing.

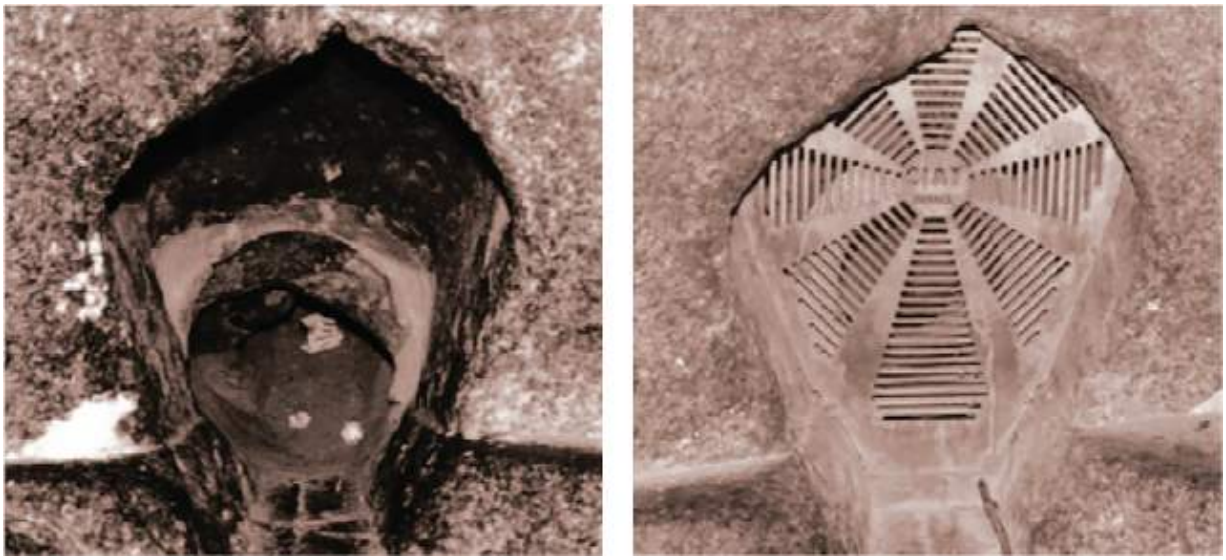

Plate 12. *Opening in south wall of Resonant Cavity leading to South Shaft. I first observed the unique microwave horn antenna-like features of this opening and photographed it in 1986 (left image). Returning in 1995 and hoping to be able to gather geometric data using a die sinking profile gage, a ventilation fan, installed by Rudolph Gantenbrink (circa 1993), presented a barrier (right image).*

Plate 13. *North Shaft opening in the north wall of the Resonant Cavity. Dimensions of 8.4” wide by 4.8” high make it suitable for a hydrogen microwave signal with a wavelength of 8.309 inches (21 cm). Note: North and South openings are directly opposite each other.*

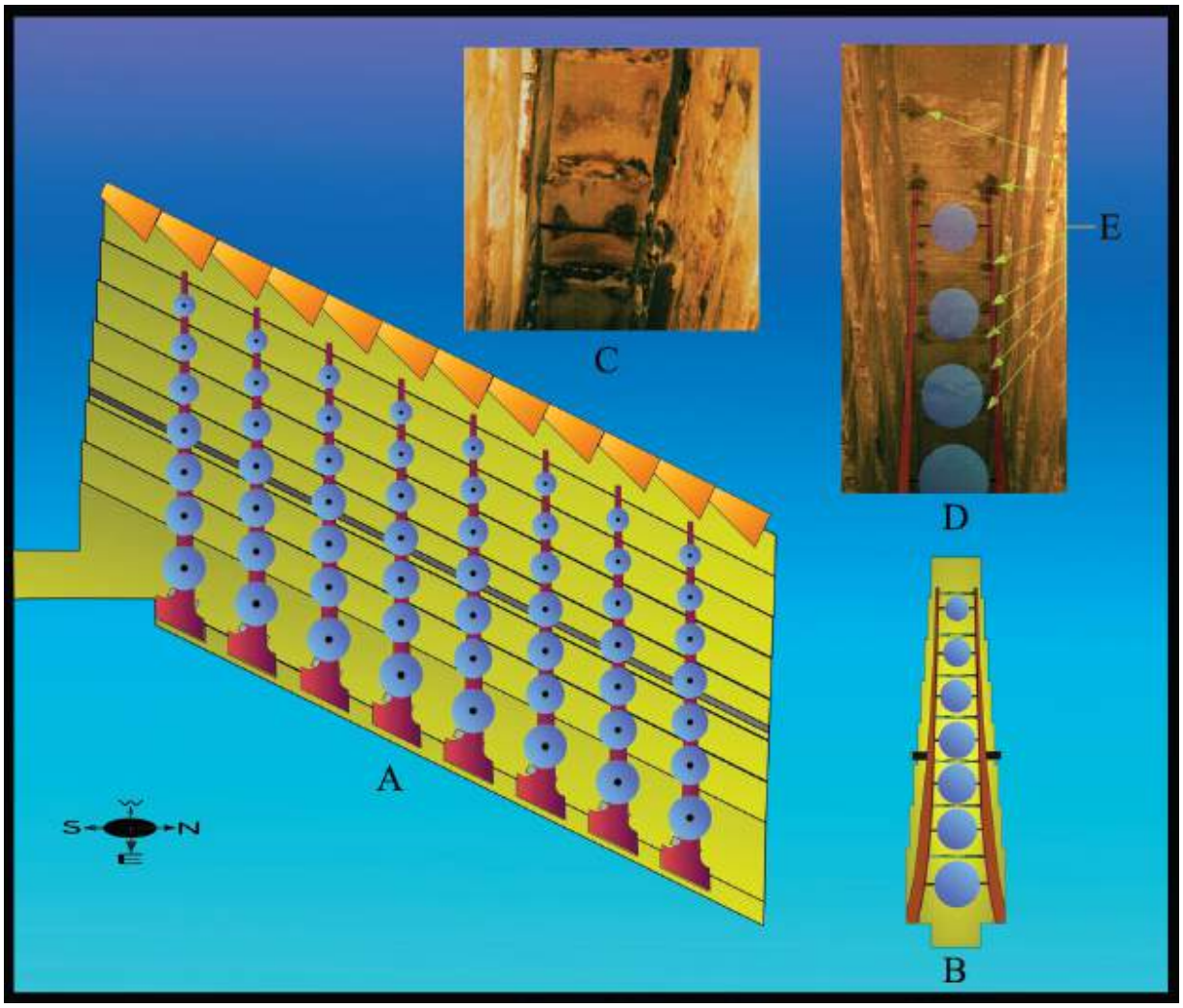

Plate 14. *Section of acoustic amplifier showing 8 of 27 resonator stacks.*
A: East-West Cross Section. Resonator frames are locked into position using recesses cut into the side ramps. Vertical orientation is established by using the slots cut into the corbel along the length of the east and west wall.
B: North-South Cross Section.
C: Close up photograph of scorch marks on ceiling of Grand Gallery after the interior of the Great Pyramid was cleaned. Photograph taken in 2001.
D: The Grand Gallery illustrating the correlation between the pairs of scorch marks (E) and the resonator frames that were first discussed in The Giza Power Plant, *13 years earlier.*

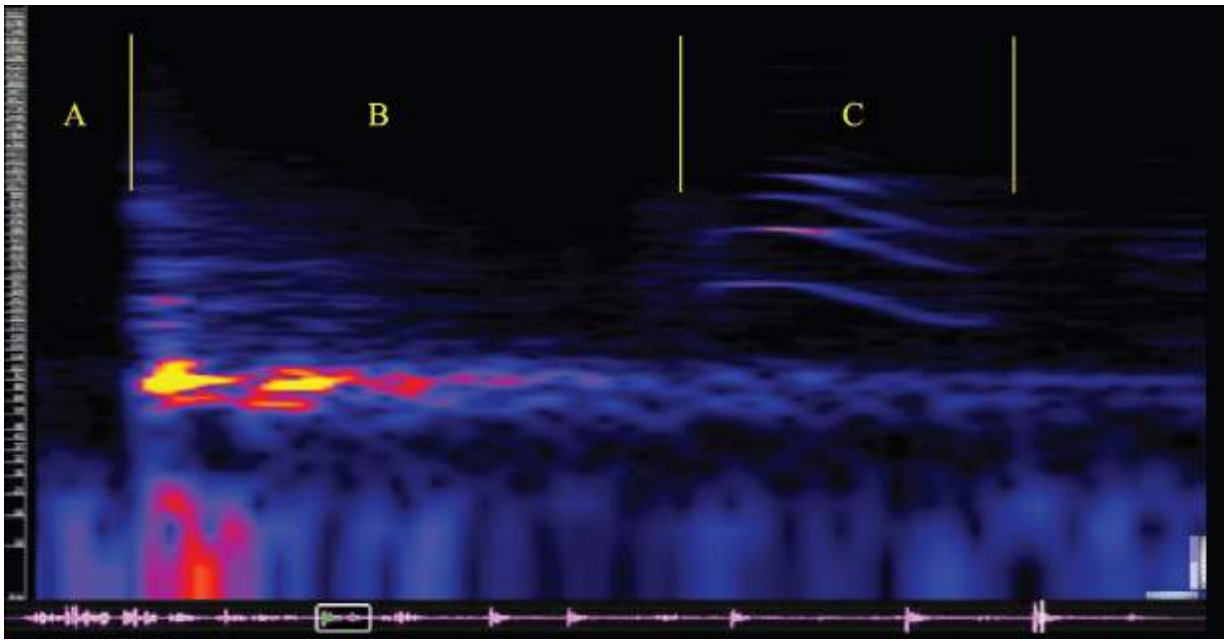

Plate 15. *The powerful acoustic properties of Great Pyramid's inner chambers and passages have long been of intense interest. In 2019, sound engineer Robert Vawter, using a Tascam recorder, performed a simple test by stomping on a loose board near the lower end of the Grand Gallery. This image shows the resulting acoustic spectra. (See Appendix A for more details).*

A: Gallery is silent except for low pulsing infrasonic frequencies at around 5–20 hertz. These frequencies continue through the duration of the recording.

B: Vawter stomps on the loose board, resulting in a broad-spectrum response from the Gallery's corbels.

C: Vawter's wife Helen says "WOW" when hearing the reverberation.

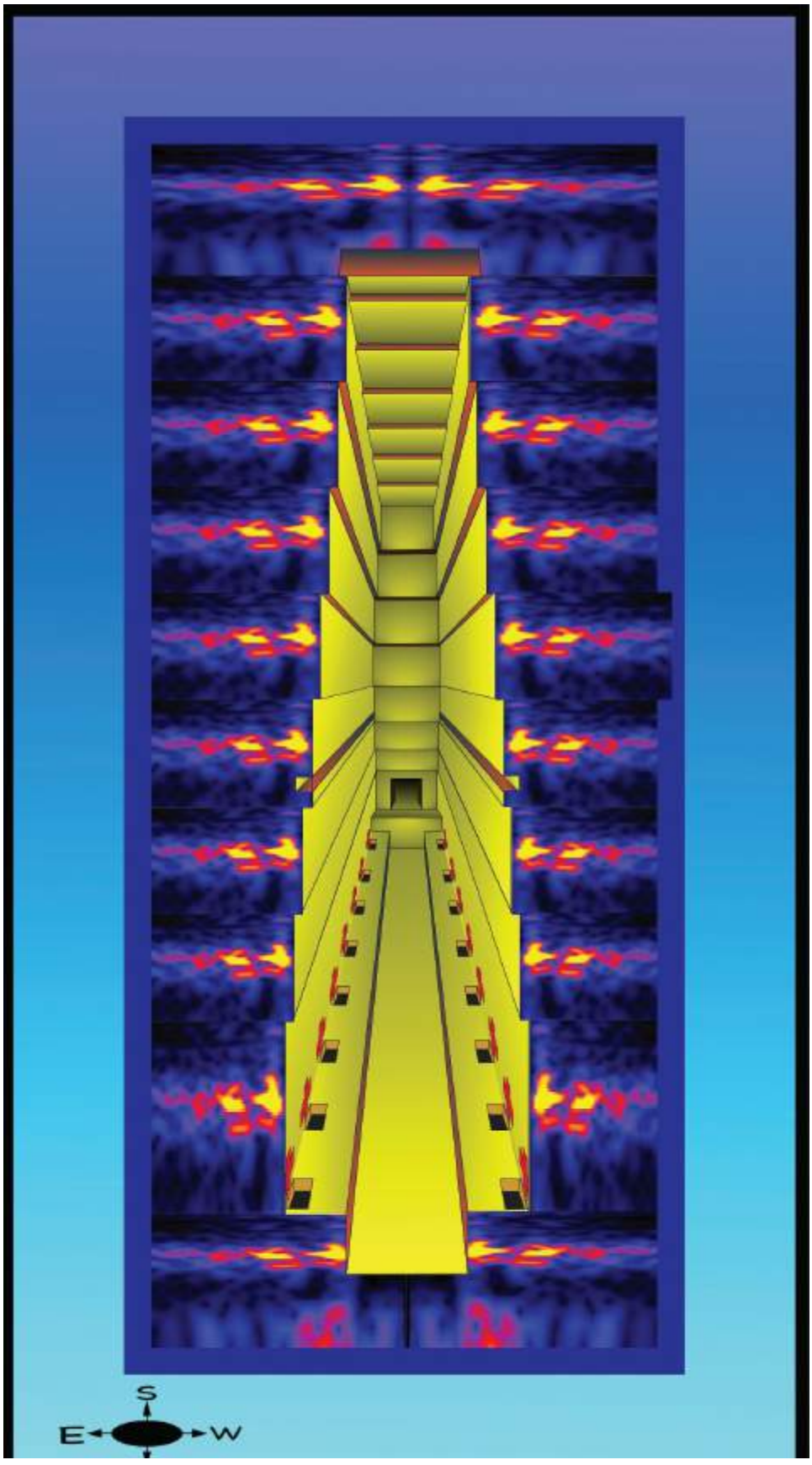
S
E
W

Plate 16. *Robert Vawter's spectra with Grand Gallery illustrating corbels responding at different frequencies to sound input. Note: This graphic is for visual effect and is not intended to suggest that the acoustic spectra gathered inside the gallery exists within the limestone wall blocks.*

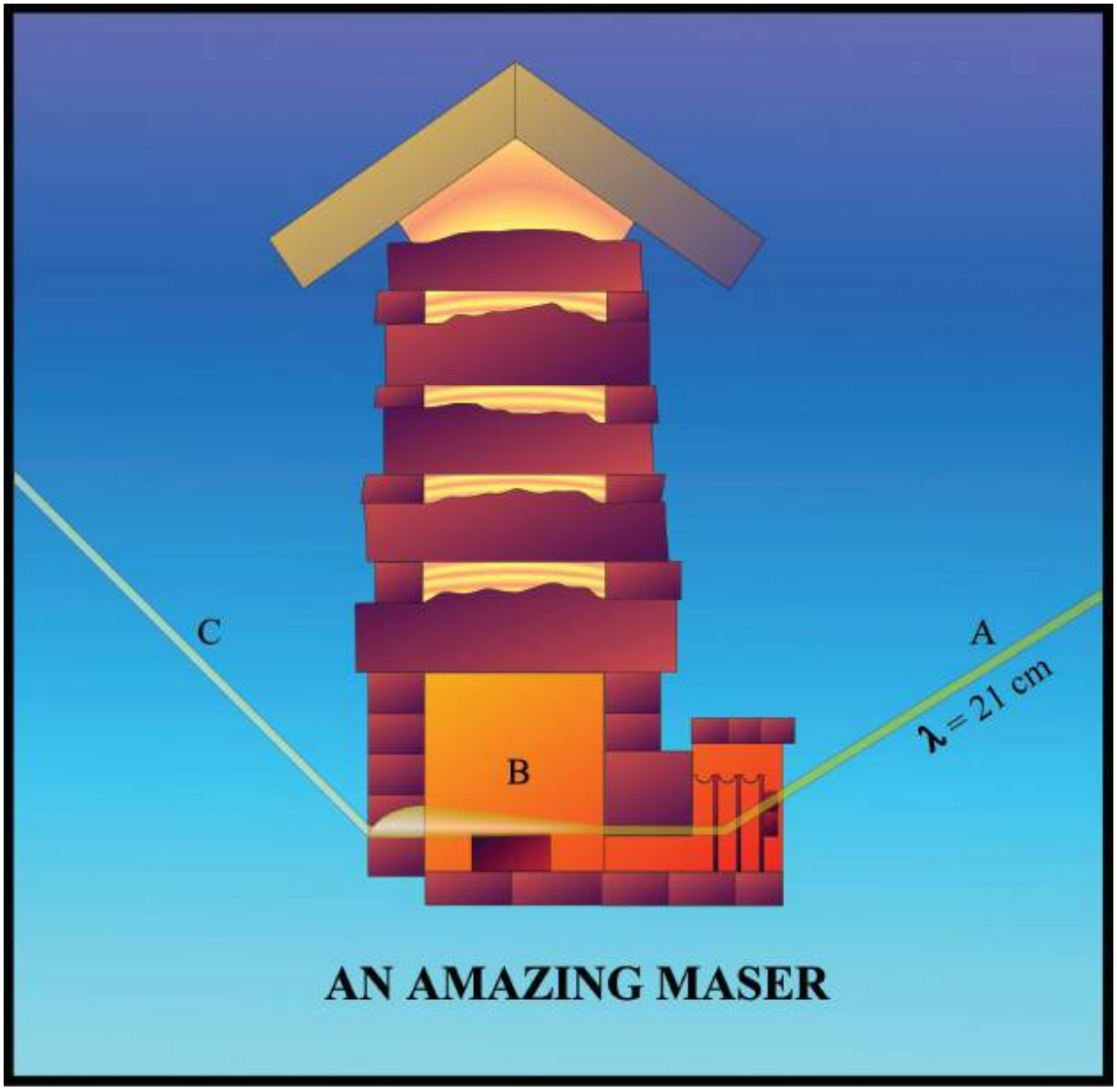

Plate 17. *The King's Chamber shaft positions suggest a flow of energy and maser (microwave amplification through stimulated*

emission radiation) activity. Electrons are stimulated to flow not just from the igneous rock within the Earth but also from the thousands of tons of igneous rock (rose-red Aswan granite) from which the power center (aka King's Chamber) is constructed. Vibrating mass of granite + "Freund Effect" + hydrogen = pollution-free power plant.
A: Microwave signal input.
B: Resonant Cavity containing highly energized hydrogen.
C: Similar to how a laser operates, except in the microwave region of the spectrum, the input signal stimulates emission from the energy-pumped hydrogen, which then exits the power center through a south shaft that has an opening similar to a microwave horn antenna.

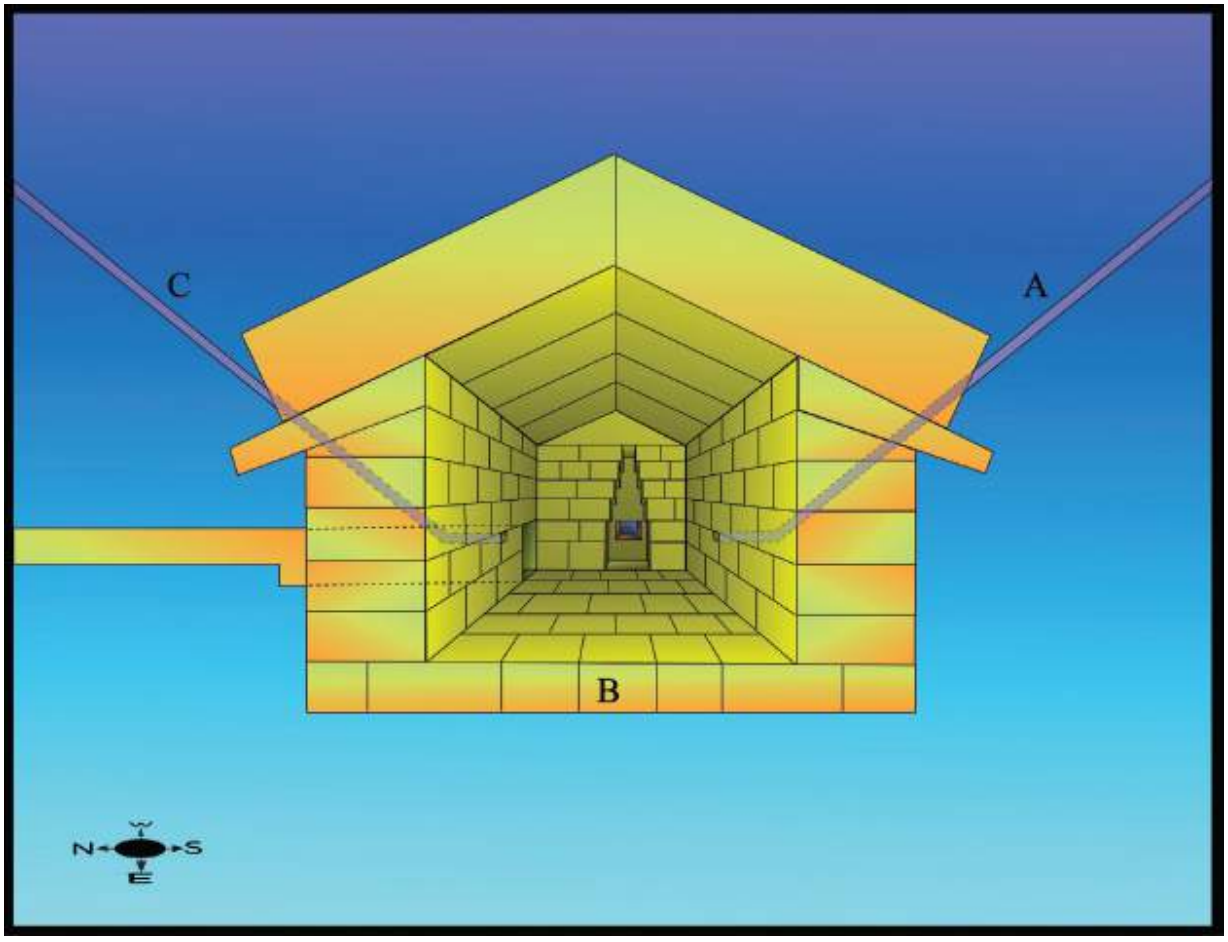

Plate 18. *Hydrogen production chamber (see Appendix D).*
A: Chemical inlet shaft.
B: Mixing vessel.

C: Chemical inlet shaft.
Note: The author proposed that the chemicals used were hydrated zinc and dilute hydrochloric acid were mixed to produce hydrogen, which flowed into the Resonant Cavity and pumped to a higher energy level by acoustic and electromagnetic energy. Appendix D, written by Dr. Brett Cohen, present other alternative solutions for creation hydrogen.

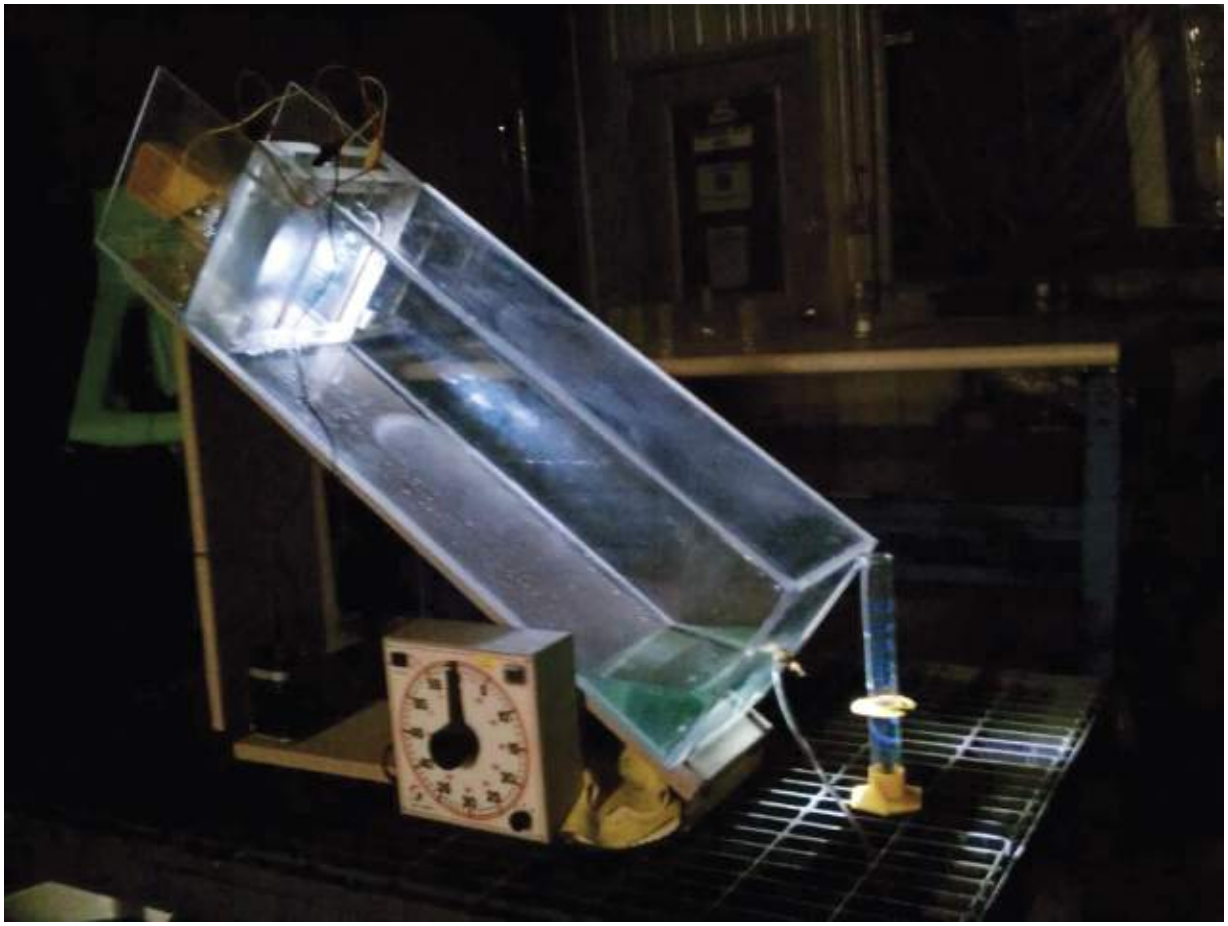

Plate 19. *Author's model of chemical delivery shaft to demonstrate function of metal pins in the blocking stone at the end of the shaft. The experiment was successfully demonstrated to work and was recorded by Ancient Aliens for the History Channel. The shaft was filled with water until it covered the pins, at which time it created a circuit which turned on a light. This photograph was taken after the tank had drained and the light was turned on for visual effect.*

Plate 20. *Left to right. Robert Vawter, Chris Dunn, and Friedemann Freund at the SETI Institute. (See Appendix A and B.)*

Plate 21. *Eric Wilson in Egypt (see Appendix C). Image credit: Lauren Kurth, Eric Wilson.*

About the Author

CHRISTOPHER DUNN is a retired aerospace manufacturing engineer. He has published dozens of articles on ancient technology and has appeared on the History Channel, the Travel Channel, Discovery Channel, The Learning Channel, and PAX Television. The author of *The Giza Power Plant* and *Lost Technologies of Ancient Egypt*, he lives in Illinois.

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Sharing extensive new evidence and cutting-edge research that the Great Pyramid at Giza was built as an energy-harvesting machine, Christopher Dunn details how the ancient Egyptians generated clean power for their civilization and reveals how the pyramid builders and the great inventor Nikola Tesla drew from the same universal knowledge.

Looking at each part of the Great Pyramid, from the internal chambers to its massive stone blocks to the pyramidion on top, Dunn reveals how the pyramids in Egypt served to stimulate the release and collection of electrons in the Earth's crust by harmonizing seismic energy while also attenuating the accumulating stresses. Drawing on exhaustive ongoing research by NASA scientists into the phenomenon known as "earthquake lights," Dunn shows how the pyramid builders were inspired by this phenomenon and learned to stress igneous rocks in order to harvest the resulting electron flow. He looks in depth at recent research that supports the pyramid energy theory, including new explorations of the shafts of the Queen's Chamber and analysis of the scorch marks on the ceiling of the Grand Gallery, which supports the King's Chamber explosion hypothesis. He examines the stunning significance of the large void above the Grand Gallery discovered in 2017. Dunn also analyses the results of extensive acoustic testing and measurements at ancient sacred sites and shows how the pyramids were tuned to the Earth's frequency.

While the pyramids' sophisticated energy-harvesting abilities are now in disarray and disuse, some remnants of their technologies are still there, waiting to be rediscovered and provide our civilization with an abundance of nonpolluting power.

CHRISTOPHER DUNN is a retired aerospace manufacturing engineer. He has published dozens of articles on ancient technology and has appeared on the History Channel, the Travel Channel, Discovery Channel, The Learning Channel, and PAX Television. The author of *The Giza Power Plant* and *Lost Technologies of Ancient Egypt,* he lives in Illinois.

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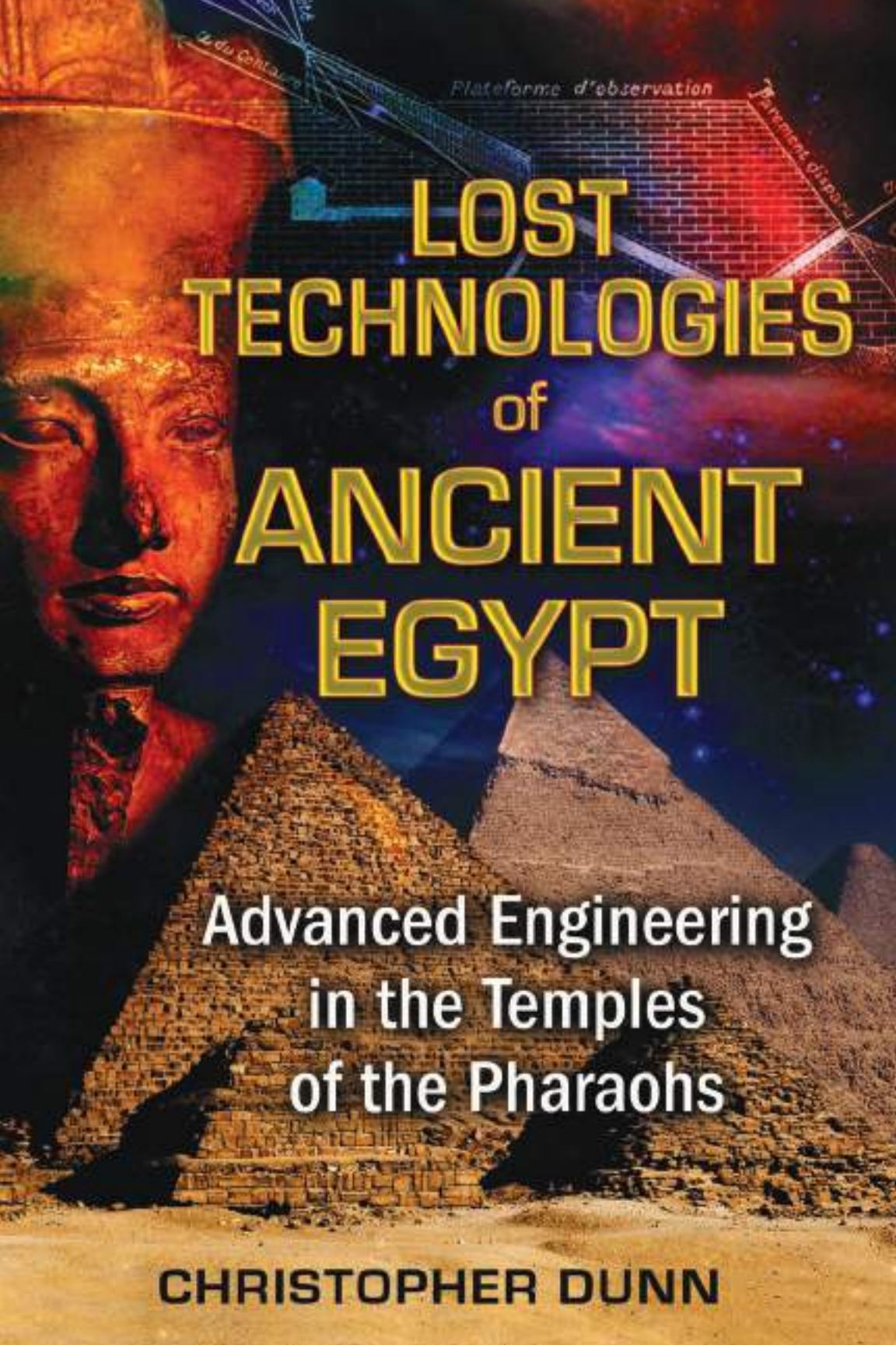

LOST TECHNOLOGIES of ANCIENT EGYPT

Advanced Engineering in the Temples of the Pharaohs

CHRISTOPHER DUNN

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LOST TECHNOLOGIES of ANCIENT EGYPT

"Christopher Dunn is an expert in his field. He knows a great deal about stone-cutting tools and has spent many years studying the ancient Egyptian monuments, sculptures, and artifacts. His findings are revolutionary. His word carries weight. If he is right, our perception of who the ancient Egyptians were may completely change. Read this book!"

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"Admirers of Egyptian art and architecture are most fortunate that Christopher Dunn directs his experienced engineer's eye toward the Egyptians' ancient stonework. By noticing the most minute details he reveals sophisticated craftsmanship and immense significance for all areas of Egyptology. Mathematicians will appreciate the amazing three-dimensional geometry made manifest in very hard stone. Dunn points the way for geometers to uncover sharper, more accurate analyses of the proportions of Egyptian design. This book is an important contribution to scientific scholarship by showing how archaeology can firmly rest on a measurable foundation."

Michael S. Schneider, author of
A Beginner's Guide to Constructing the Universe

"In this book, Christopher Dunn has brought to the field of Egyptology a new approach, which has been needed for decades. His ability as an engineer and master craftsman has given him the insight to discover ancient technologies and techniques that have been missed by traditional Egyptologists. This book is a paradigm change for the way of thinking about our ancient history and ancestors. I highly recommend this beautiful illustrated book to both academic and alternative researchers and for anyone interested in new ways of thinking about our ancient past."

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the Great Pyramid of Giza Research Association

"As with Newton and the apple, Chris Dunn got a vision when visiting Egypt. His engineering background allowed him to unleash incredible facts, and thanks to this highly detailed book, we can now share the same marvels."

Alain Hubrecht, architect, writer, professor, and
founder of the Association Transpersonnelle Belge (ATB)

"If you want to see the precise high technologies ancient Egyptians really had, read this book. It is a serious donation to Egyptian legacy and an opus for the future of this planet."

Antoine Gigal, author, researcher,
and president of Giza for Humanity

"I believe, as Chris Dunn superbly details in this book, that ancient Egyptian sculptors and architects were so precise and their works so monumental that they must have used sophisticated technology, probably hidden in their time and now lost to ours."

Mike Leckie, stone sculptor

LOST TECHNOLOGIES of ANCIENT EGYPT

Advanced Engineering in the Temples of the Pharaohs

CHRISTOPHER DUNN

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To the Egyptians and their
glorious heritage

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FOREWORD

Shifting Paradigms

In the mid-1990s I was co-founder of a NASDAQ-listed software company in Albuquerque, New Mexico, which specialized in presenting digital data in a unique 3D immersive graphical environment (also called virtual reality, or VR). One particular time, we showed the results of our VR work to an undersecretary of the US Department of Transportation—an abstract presentation of rather mundane DOT traffic data from various road intersections around the nation. Because of the intuitive display system, without any interpretation training at all, the undersecretary was able to see patterns, anomalies, and trends in his data, striking evidence of unexpectedly massive distortions and errors, perhaps even fraud, resident in his measurements but unseen before.

So shocked was the bureaucrat that he told the audience of several hundred technophiles, "I will never be able to look at my new data the same way again. Not only that, I won't even be able to look at my old data the same way." From this honest and open spontaneous reaction, I coined the saying, "A paradigm shift not only changes the future, it changes the past!"

What researcher Christopher Dunn has accomplished in *Lost Technologies of Ancient Egypt* and in his previous work, *The Giza Power Plant,* is more than a paradigm shift; it is more of a paradigm seismic event. Because once a person with a manufacturing or machining background—engineer, technician, machinist, artisan—reads and understands what Dunn has discovered and analyzed in ancient Egyptian

stonework, that person will never look at ancient Egyptians the same way ever again. That reader will become skeptical of portrayals of ancient Egyptians as primitives in any sense. That reader will begin to analyze every new Egyptian archaeological discovery, to see what else conventional Egyptologists have overlooked. That reader will become part of the new paradigm.

In these pages, Chris Dunn demonstrates an underlying system of incredible precision in the machining, layout, and positioning of both individual objects and groups of features, ranging from the toolmark details in the "Rose Red Rosetta Stone of Abu Roash" to the symmetries of the giant heads of Ramses at the temples in Luxor, to the layout of the column capitals of the Great Hypostyle Hall at Denderah, to the base of the Great Pyramid itself. Thanks to this work, the modern reader sits back in awe and admiration of the Egyptian geniuses of five thousand years ago. The ancient artifacts contain amazing messages, but the stones cannot speak for themselves. This book speaks for them.

In November 2008, I accompanied Mr. Dunn and others to what some have called "the Lost Pyramid" at Abu Roash, some ten kilometers northwest of Giza. I was anxious to see the rose-colored granite piece that the author had described to me years before, anticipating seeing the compound radial cuts and distinguishing toolmarks. I was not disappointed. To any technophile, this one cut stone exhibits mute arguments against primitive tools and primitive peoples. More than any other artifact, it embodies an ancient "language" that still speaks to modern engineers. I immediately dubbed it the "Rose Red Rosetta Stone of Abu Roash."

I called the stone a "Rosetta" because its discovery reminded me of another paradigm-changing artifact: in 1799, Napoleon's soldiers found a curious object embedded in a wall of an Egyptian village. Their original report, "A Report on a Stone Found in the Village of Rosetta," describes a black rock slab inscribed with three languages, one of them being ancient Greek, the others the unknown Egyptian hieroglyphic writing and the cursive or "demotic" Egyptian writing. Reading the Greek portion, the antiquarian Champollion was able to translate

the names of the Pharaohs—written within cartouches—and thence the rest of the hieroglyphic writing itself. He opened up an eventual understanding of the millions of carved figures decorating the ancient temples and tombs of the Nile. Nobody would ever again look at the hieroglyphic carvings as mere magical, mystical figures, but would read the translations of experts who deciphered those cuts and reliefs, uncovering the lost history of Egypt.

The Rosetta stone thus facilitated a change in the worldview of moderns who looked back at ancient Egyptians. Nothing would ever be the same. I maintain that this book has accomplished a similar feat, every bit as meaningful to an understanding of ancient Egypt, if not more so. Once understood, Dunn's discoveries will forever change the perception of the serious researcher.

In a similar manner to Champollion reading ancient Greek and comparing it to the unknown hieroglyphic figures, researcher Christopher Dunn was able to "read" the machine-cut tool marks on the Abu Roash stone and compare them to those made by modern tools capable of the same operations. With years of experience and a trained eye for such details, and armed with the proper paradigmatic perspective, Dunn was able to recognize at once what it meant to produce a stone with a curved cut some 37 feet in diameter, and to reproduce that cut in small, uniform steps across a three-foot width—over 700 nearly identical radial tool cuts! This feat is simply not achievable by human hand alone, using any known tools.

Such toolmarks require at the very least a large saw blade or cutting tool, and sophisticated fixtures to produce the steps between cuts. To suggest that the primitive tools ascribed to the ancient Egyptians could have produced anything like these markings is ridiculous. In my opinion, this machined stone by itself demonstrates the existence of sophisticated tooling that did not exist again until the 1900s.

To the modern engineer, machinist, or toolmaker, the toolmarks on the Rose Red Rosetta Stone of Abu Roash are proof enough that the ancient Egyptians possessed technologies not replicated until the twentieth century—if even then. But *Lost Technologies of Ancient Egypt*

shows more examples, each of which have similar impact—the Ramses heads in Luxor, the carvings and columns at Denderah—further reinforcing the genius of the ancient machinists, engineers, designers, and planners. Taken together, they represent arguments in stone that refute current Egyptological conclusions.

When civilization fails for any reason, metals of all kinds become precious commodities. They become knives, spear points, scrapers, fishhooks, even plows. Ancient Egypt underwent numerous upheavals caused by droughts, earthquakes, civil wars, religious strife, and foreign invasions. During the times of collapse, the advanced metal tools that the ancient Egyptians used were probably disassembled, cut apart, or melted down. What wasn't immediately used would corrode and disappear after thousands of years. And perhaps some other advanced technology was also employed, the remnants of which we wouldn't recognize today.

Large saw blades and other machine tools, if not secreted away from armies, earthquakes, floods, and mobs, would not endure very long. Over the millennia, few metal objects from our own time would survive or be recognizable. *Life After People,* a popular cable television show that debuted in 2009, shows example after example of the deterioration of manmade objects after years, merely because of lack of maintenance. In five thousand years, approximately the timespan estimated in *Lost Technologies of Ancient Egypt,* almost nothing of today's technology would be left. In a world of resourceful (and destructive) human beings, the devastation would be much worse than Mother Nature alone could cause; marauding bandits and nomads would re-use, recycle, or otherwise destroy even our ubiquitous automobile engine blocks and our porcelain toilet bowls!

It may be that future archaeologists will one day uncover an untouched ancient factory or workshop under the sands or in the caves of Egypt, a place that was purposefully hidden away from destructive recycling, a place that would show us exactly what the ancients used and how. Such a discovery would be the equivalent of the unexpectedly sophisticated two-thousand-year-old Greek computational mechanism, the Antikythera Device! But to recognize their finds as evidence

of ancient technologies, those future discoverers must have minds that are opened to the possibilities that Christopher Dunn has been the first to reveal. Otherwise, that advanced machine shop of the ancients could wind up stored in unnumbered boxes in the basement of the Egyptian Museum in Cairo, labeled merely as "funerary objects."

Recent discoveries at the archaeological site Göebekli Tepe, in Turkey, indicate that twelve thousand to thirteen thousand years ago, so-called primitives were erecting T-shaped monuments as tall as six meters, ranging in weight from ten to fifty tons, perhaps building a Neolithic cathedral of sorts. Many of these stone pillars exhibit carvings of wildlife and even some human-shaped reliefs. For unknown reasons, the site was deliberately buried approximately ten thousand years ago. Because this site can be dated as existing prior to previously established dates for the beginnings of agriculture and urbanization, not to mention cooperative construction of stone monuments, we can readily believe that conventional chronology is at the least incomplete, if not wholly inaccurate. We see that every new archaeological discovery pushes back civilized development further and further into the past, never in the opposite direction.

So here we have evidence of moving massive stones and carving them in intricate detail dating earlier than 10,000 BCE—thousands of years before the ancient Egyptians were believed to have begun the stone machining that the author examines in this volume and in his previous works. Several thousand years passed between the time of Göebekli Tepe and that of the Egyptian First Dynasty, millennia in which artisans and engineers of ancient times could have perfected their craft, invented their complete suite of enabling tools and supportive technologies, and eventually emigrated to the Nile Valley, becoming part of the incipient civilization emerging there. With centuries of experiment and practice, those who worked in stone could have kept their knowledge secret, offering their finished products to leaders, priests, and the wealthy. As Dunn points out in this volume, even today trade secrets and proprietary knowledge are closely held, even in an educated worldwide civilization with widespread literacy and training. In ancient times

the impulse to secrecy may have been even more necessary for survival.

Alas, the human beings who worked the Rose Red Rosetta Stone of Abu Roash, who machined the statues of Ramses, the columns of Denderah and the stones of the pyramids, were more fragile and evanescent than the mighty tools they employed in their work. If tools of metal are lost in war or natural catastrophe, their flesh and blood designers and operators are even more subject to the vagaries of Fate—disease, injury, wounds, and famine can take away technicians, inventors, planners, and managers, while leaving behind marvelous tools fit only for destruction by desperate people ignorant of their value.

If the knowledge of a specific task, the operation of a given machine tool, or the procedure for laying out vast projects is resident in just a few people, maybe just one, then the loss of that person or group means the knowledge is gone forever, unless it is recorded. This is an eternal problem, not limited to the ancient Egyptians of five thousand years ago. As a modern example, in 1992 while working at the White House Science Office, I invited to a meeting there a person from the National Science Foundation. Although only peripheral to the agenda, this older scientist regaled us with a tale of a lost technology of modern times, namely how to start up the engines of the Saturn V rocket that took American astronauts to the Moon from 1969 to 1972. Incredibly, this leading scientist averred that no one was alive who knew how to start up the engines on the largest rocket ever flown. No one had written down the standard operating procedure, and the rocket men who had developed the technique had all passed away.

So in 1992 CE or 1992 BCE or further back in time, we can find sufficient examples to demonstrate that technologies are not always lost as a result of conspiracy. Ordinary human pride, greed, stubbornness, selfishness, and even carelessness, can account for much of our loss.

In two groundbreaking works, author Christopher Dunn has opened our eyes that ancient Egyptians, and maybe others in the past, designed, planned, laid out, and precisely machined stone statues that would be difficult to reproduce even with today's manufacturing technologies. As the first person to uncover and develop this new paradigm, he has

gone on to investigate other ancient Egyptian artifacts, temples, tombs, and pyramids using this new way of looking at information. He has retrieved knowledge that all before him have overlooked, save Flinders Petrie, whose interest was not primarily proving advanced ancient technology, merely commenting upon interesting findings. A new way of looking at old data could bring new respect to ancient civilizations that left magnificent ruins in a still-troubled part of the world. As we understand more about the origin of Egyptian temples and pyramids, we find a way to bridge the past and the present, a way to look for still other revelations that affect us as human beings.

Arlan Andrews Sr., ScD

Arlan Andrews Sr., a registered Professional Engineer, graduated from New Mexico State University with a doctorate in mechanical engineering. Throughout his career he worked as a missile tracker at White Sands Missile Range, as a member of technical staff at Bell Telephone Laboratories, as the advanced manufacturing initiatives manager at Sandia National Laboratory, and as the environmental director at the Naval Air Station, Corpus Christi, Texas. In 1991, Dr. Andrews was assigned to the Technology Administration of the U.S. Department of Commerce as a Fellow for the American Society of Mechanical Engineers (ASME). Following his tenure there, he became an ASME Fellow at the White House Science Office. He later co-founded several high-tech startup companies, one of which was listed on NASDAQ and another still operating in North Carolina. He also founded the nonprofit futurist organization SIGMA, a group of professional scientists and science fiction writers formed to advise the Federal Government on future technologies and events.

FOREWORD

Recognizing the Brilliance of Ancient Manufacturing

No one can be a great thinker who does not recognize that as a thinker it is his first duty to follow his intellect to whatever conclusions it may lead. Truth gains more even by the errors of one who, with due study, and preparation, thinks for himself, than by the true opinions of those who only hold them because they do not suffer themselves to think.

John Stuart Mill, *On Liberty*

As a lawyer trained in the areas of evidence and the nature of proof, I have witnessed firsthand the disagreements that occur in the arena of ideas. Sometimes these disagreements make their way into a courtroom, where a trial is held and a judgment made as to which opinion carries the weight of evidence—evidence that ultimately convinces a judge and jury. The court reaches a decision in favor of the party or parties that presented that convincing evidence.

Over the course of this book, Chris Dunn presents evidence that raises a multitude of challenging questions, introducing new ideas and

opinions about the history of craftsmanship in Egypt. This work calls into question established paradigms and theories that have, for many decades, formed the basis of academic studies in schools and universities around the globe and in volumes that occupy the shelves of virtually every library. But first, let me describe how I came to be involved in this debate.

Leaving the formal practice of law in the late 1980s, I have, in the ensuing two decades, become a manufacturer, more specifically a fabricator of sheet metal components for gas turbine engines at Danville Metal Stamping Co., Inc., located in Danville, Illinois, USA. It was here that I first met Dunn, upon my arrival at Danville Metal in 1988. He preceded me at the company by a couple of years and was then serving in the capacity of laser engineer. He later became a manufacturing engineer and, in 1995, brought his manufacturing and engineering skills, as well as his judgment and insight, to the post of Human Resources Manager. As President and CEO, I devote a significant amount of time to human resources and, consequently, my contact with Dunn increased dramatically.

At that time, I had little background or particular interest in Egypt, the pyramids, or ancient technologies and civilizations. Nonetheless, like most humans, I had a natural curiosity about how things are made or done and why. My curiosity then turned toward the subject that Dunn had spent the past twenty years studying in his spare time, and I was impressed by the enthusiasm and sense of wonder he had for it.

Over breakfast after a Sunday walk, Dunn would discuss his thoughts on ancient technologies. Those discussions were often supplemented by a photograph or other visual aid, such as an engineering drawing or a sketch on a napkin or scrap of paper. We would also discuss the online controversies that swirled around his comments, theories, and questions raised in his first book, *The Giza Power Plant*. Dunn's analysis did not stop there; he instead applied the criticism he received to improve his methods and collect further evidence.

In February of 2006, Dunn took another of his many trips to Egypt, this time with a tour group that visited a number of temples in Upper

Egypt. Although he had first visited those temples in 2004, his exposure had been brief and he was interested in more closely inspecting temple artifacts, especially in the Luxor Temple. This new expedition took Dunn deeper into and beyond the issues he had explored previously. He returned from the trip with a new and elevated interest in the accomplishments of the ancient Egyptians in the temples, particularly the statuary. His observations in the temples presented a new frontier of amazing feats, raising questions that were complementary to observations he had made in connection with granite boxes and other aspects of construction in the pyramids.

In April and May of the same year, I took the opportunity to travel with Dunn to witness in person what I had only examined as photographic evidence. This included many looks through the viewfinder of his camera equipped with a telephoto lens and then verifying the results captured by the camera.

From personal observation, I can verify that in this book Dunn has been true to the evidence he observed. As an engineer, Dunn was able to analyze his observations with CAD/CAM programs and geometrical analysis unavailable or incomprehensible to the average observer. Among other things, with advances in digital imaging, a technology used daily in manufacturing, his computer-assisted analysis afforded him the ability to see attributes that could not be seen or analyzed with the naked eye even in the presence of the original artifact.

Using his extensive skills and his tools as an engineer and a toolmaker and bringing to bear his decades of experience in manufacturing, Dunn was relentless in assessing what he could reach and, through his camera lenses, preserving that which he saw. He also used his camera to capture what he could not necessarily reach and was thoughtful and creative in his approach. As the reader will witness in the pages that follow, Dunn thinks well in three dimensions and understands thoroughly the consequences of a particular test, comparison, or view.

After our visit to the temples in 2006, Dunn studied his photographs and detected in the statues certain features that resembled tool marks—the kind of tool marks that a craftsperson or engineer would

recognize. Realizing that he had focused on collecting geometric information and neglected to look for evidence of tool marks, another trip was planned and taken in November of 2008 to further authenticate and more finely focus on what his previous photographs indicated. On this trip I was able, through Dunn's camera, to see the tool marks on the cheek of one of the Ramses in the Temple at Karnak, even though the head of that statue was some 45 feet in the air. I was later able to examine the resulting photograph, as can the reader later in this book.

I vividly remember my first (and then every subsequent) visit to the Luxor Temple. Although smaller than the nearby Temple at Karnak, the Luxor Temple is impressive. The different areas of the Temple provided an interesting variety of architecture from the hall of the Ramses to the colonnade to the plaza to the inner temple. Each had something different to offer and yet they harmoniously fit together. The imposing Ramses statues hewn out of huge solid blocks of granite, the immense columns, and the fact that the Temple, its contents and its surrounding have existed for thousands of years caused me to wonder about the influence it had on the civilization that built it. From these thoughts, my mind was opened to a new awareness.

As I am confronted with the evidence, both in Dunn's book and from my own personal observation, I find myself wondering, among other things, how the technology of the ancient Egyptians that allowed them to carve and shape stone as they did was applied in other areas of their society, such as healthcare and dentistry for example. In our society, advancements in one area of technology are quickly spread to other areas in which those advancements might apply. Wouldn't the ancient Egyptians have done the same?

While my background as an attorney and a manufacturer qualifies me to evaluate Dunn's work objectively, I am still awestruck by what he has revealed in his studies and by the disparity between his findings and the understanding I gained in the course of my traditional education on the subject. If, metaphorically speaking, truth lies at the heart of an onion, I have witnessed firsthand as Dunn peeled away layers of that onion to get closer to the heart of technologies employed in

ancient Egypt, revealing previously unaddressed questions. While the most obvious and prominent of those questions is *how* these ancient artifacts were made to exhibit such remarkable geometry and precision, the second most obvious that follows quickly on the heels of the first is *why*.

At this time, there are no certain answers to these questions, and it is human nature to fill the void of the unanswered question with something. Those who ignore questions because the answers are not apparent are disingenuous. I am reminded of this quotation from John Stuart Mill in *Considerations on Representative Government:* "From despairing of a cure, there is too often but one step to denying the disease; and from this follows dislike to having a remedy proposed, as if the proposer were creating a mischief instead of offering relief from one."

A skeptic is defined by *Webster's* as "a person who questions the validity or authenticity of something purporting to be factual," while the same dictionary defines cynical as "distrusting or disparaging the motives of others." In his work, Chris Dunn invites us all to be skeptical of things that we may have never really questioned while, at the same time, he invites rigorous skepticism of his own observations. This skepticism is healthy and helpful. It is not cynicism, however. It is not contempt for the theories or ideas of others or for those who proffer those theories or ideas. It is a questioning and a testing of one's own ideas and theories as well as those of others. In reading and contemplating the pages that follow, I entreat the reader to be skeptical but not cynical.

In exercising skepticism while reading Dunn's work, also bear in mind this quotation from the Wizard in the play "Wicked": "Back where I come from we believe all sorts of things that aren't true . . . we call it history."

Perhaps a more famous Winston Churchill quote, "history is written by the victors" should be considered. The history of Egypt traditionally taught in the west has, for the most part, been written by western scholars who followed on the heels of their armies. I am confident that the obvious sophistication of the ancient Egyptians revealed in this book will, in due time, prompt western scholars and others around the

world to reexamine what has been written about ancient Egypt and to consider what else the citizens of that ancient civilization, by whatever means, accomplished.

Judd C. Peck, Esq.

Judd C. Peck graduated from the University of Illinois College of Law (magna cum laude) in 1978. In 1989, he took the helm of Danville Metal Stamping in Danville, Illinois, and became its President and Chief Executive Officer.

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Introduction

Tell me, Mr. Hoover, what are your interests?
Madam, I am an Engineer.
Really? I took you for a gentleman.

Herbert Hoover, conversation on making the acquaintance of a lady on a steamship

It is possible that Mr. Hoover's confused lady acquaintance had the wrong impression of what an engineer does, since a train driver is also known as an engineer. There are mechanical engineers, electrical engineers, materials engineers, computer engineers, construction engineers, quality engineers, and safety engineers. And all may not be considered gentlemen—many you may meet will be ladies. Each engineer works in a specialized field, and within those particular disciplines are subgroups that work in myriad industries that form the fabric and backbone of modern civilization. Of themselves and their machines, the life of an engineer is frequently punctuated with Scotty's *Star Trek* lament, "Can't take much more o' this, Captain!"

Perhaps unbeknownst to you, the engineers' labors have a direct affect on your daily life. For instance, you have just arrived in the office, hung up your coat, and poured yourself a cup of your favorite morning beverage. An army of engineers and artisans worked to create the technology that has allowed your morning ritual to happen. Crafted into the

car, train, or bus and the elevator that carried you to your destination are the labors of the modern artisan. At some location miles away, perhaps on another continent, the skillful eye and hands of artisans guided the tools that created the coffee maker and processed the coffee.

The Industrial Revolution of the 1800s propelled Western civilization forward in terms of labor-saving devices. Around this time, many of the machines that are now used in manufacturing were either invented or improved. Yet the most basic of machines, the lathe, has been around in one form or another for centuries—originally in the form of a potter's wheel. Its development as an efficient metal-cutting machine grew from the invention of the steam engine, which powered everything from textile mills to Stephenson's Rocket, the first steam locomotive to convert linear motion to rotary motion and use that rotary motion to propel itself along two rails at the dizzying speed of twenty-five miles per hour.

In the past sixty years, technology has advanced rapidly in directions that many people, except science fiction writers and futurists, could not even have imagined possible. Discoveries and innovations in the field of physics have introduced new patterns of thought in the minds of scientists and inventors. Like legs on a centipede, branches of science, engineering, and manufacturing, along with the creative genius of gifted artists who are now an essential part of the design of functional products, move forward, independently and in unison, each drawing on the other for inspiration and survival.

Three hundred years before the Industrial Revolution was in full swing, geniuses arose among their peers and made their mark, adding to the prosperity and understanding of future generations. The genius of Leonardo da Vinci, Copernicus, and Galileo is well known. During this period, mathematicians, astronomers, and philosophers laid the groundwork for the pursuit of scientific inquiry and changing the worldview of humanity and its place in the universe. With its genesis in the 1500s, what is now known as the Scientific Revolution fought against the church and superstitious beliefs to create the foundation of modern science. The heliocentric theory of Nicolaus Copernicus shattered many beliefs of the

earth's preeminence in the universe, and the Catholic church, which opposed such heresy, fought tooth and nail to stop the rush of intellect that ultimately reshaped our beliefs about nature and ourselves. René Descartes, a devout Catholic himself, cut through the confusion that had reigned for so long with a remarkably simple philosophy that to us is a part of life, but in his day was counter to the philosophy of the church, for it would ultimately challenge the church's own philosophy and teachings. In "Discourse on the Method of Rightly Conducting the Reason and Seeking for Truth in the Sciences," Descartes sets forth three guidelines that he followed in his own work:

> The first of these was to accept nothing as true which I did not clearly recognize to be so: that is to say, carefully to avoid precipitation and prejudice in judgments, and to accept in them nothing more than what was presented to my mind so clearly and distinctly that I could have no occasion to doubt it.
>
> The second was to divide up each of the difficulties which I examined into as many parts as possible, and as seemed requisite in order that it might be resolved in the best manner possible. The third was to carry on my reflections in due order, commencing with objects that were the most simple and easy to understand, in order to rise little by little, or by degrees, to knowledge of the most complex, assuming an order, even if a fictitious one, among those which do not follow a natural sequence relatively to one another.[1]

From the birth of the Scientific Revolution to the Industrial Revolution the knowledge of the world has advanced at a rapid pace. Up until today, this advancement has spanned five hundred years. Within that time we have gone from an agrarian society with a much lauded, simple, pastoral existence to a complex industrial society with products that were undreamed of when the creator of the world's first successful locomotive, Robert Stephenson, cried out, "full steam ahead!"

Punctuating each stage of civilization's development are major building projects that by necessity or demand incorporate the state-of-the-art

building construction of their period. The landscape of the ancient world is dotted with fabulous structures that are breathtaking in their complexity. The Egyptians and Mayans had their pyramids and temples. The Hindus crafted elaborate temples throughout Asia. The Greeks built the Parthenon, and the Babylonians constructed the Jupiter Temple and the fabled Hanging Gardens. The Romans made their mark all over their world, with engineering geniuses guiding the construction of their famous roads, the Coliseum, and numerous temples and viaducts, while Roman sculptors guided their chisels over marble and alabaster, giving it physical presence and beauty.

With the exception of artifacts such as the mysterious Antikythera Mechanism, an astronomical computer found by fishermen on the sea floor near the island of Antikythera in 1901, the development of technology in the ancient world seems to have clear origins and is fairly well understood.

Going back yet further in time, another deep mystery lies in the question of how the ancient Egyptian civilization could have lasted for three thousand years *without* improving the tools used to quarry and shape stone to near perfection. Since 1984, when *Analog* magazine published my article "Advanced Machining in Ancient Egypt?" controversy on this subject has persisted. The article proposed that the ancient Egyptians were more advanced than previously believed and that they used advanced tools and methods to cut granite, diorite, and other difficult-to-work stone. It does not seem credible that brilliant architects and engineers would continue to use stone tools and copper chisels for three millennia.

Following this article, I have received input from many kind people from different walks of life. Though much of the feedback I have received has been extremely positive and supportive of the idea that ancient cultures were more advanced than classical archaeology has supposed, there has been some criticism from those who believe that I went too far with my conclusions because I made the mistake of imposing a modern engineer's viewpoint on an ancient civilization, thereby ignoring its cultural origins, and disrespected the Egyptians' heritage.

In fact quite the opposite is true. Anyone who suggests that the ancient Egyptians were more advanced actually shows more, not less, deference and respect to their civilization. Such a statement does not diminish their culture in any way. Rather, such a suggestion would elevate the Egyptians' status in the world. The cultural assumptions that are disturbed most by the idea of an advanced Egyptian race in prehistory lie in the libraries and halls of Western countries and the belief system that has been generated by generations of Western scholars—beginning with Herodotus. It is our own culture's chauvinistic view of Egypt that threads throughout our history books.

Studies made by archaeologists, historians, and Egyptologists over the past five hundred years have essentially provided us with the modern, conventional view of ancient Egypt. This is an area of intense interest to engineers—such as myself—who find in Egypt a language with which we are familiar. This is the language of science, engineering, and manufacturing. Our counterparts in that ancient land left future generations of scientists, engineers, architects, and those who take their instructions and shape materials to their specifications, with a difficult challenge. This challenge is to recognize what they created and provide evidence-based, reasonable answers that give the ancient engineers credit for what they achieved. With their works, ancient engineers, perhaps unwittingly, created a sort of Mecca for modern engineers and technologists. The engineers and technologists that have taken this "pilgrimage" have discussed many theories, but always at the end we come up short of confidence that the theories are actual truth.

The ancient Egyptians who built the pyramids and temples, who crafted monumental statues out of igneous rock, were thinking with the minds of architects, engineers, and craftspeople. Were ancient archaeologists responsible for the legacy they left us? Without the advice of modern Egyptian architects, engineers, and craftspeople, are today's Egyptian archaeologists missing something? Are modern interpretations of the awesome feats of the ancient Egyptians irrelevant in providing new and powerful information about this ancient culture? Are the thoughts and conclusions of Western writers and travelers who stood in front of

the Great Pyramid one hundred years ago (or some forty-five hundred years after it was built) more intrinsically linked to the ancient Egyptian mind than those who come after them, a century or more later? What can be described as a "modern perspective?" In his time, Herodotus would surely have been considered modern. So were Egyptophiles Petrie, Marriette, Champollion, and Howard Carter—each in possession of a modern mind that was clothed in a fabric of prejudices and stereotypes that existed within their own culture.

When it comes to completely understanding the ancient Egyptians' level of technological prowess, there can be no final conclusion. What is left to study today is a mere skeleton of what existed at the time of the ancient Egyptians. This skeleton survives as highly sophisticated and precisely crafted sedimentary and igneous rock. It is my belief that the clothes we have placed on this skeleton are mere rags compared to what should be there. I have proposed in the past that higher levels of technology were used by the ancient Egyptians, but you will find in this book that I have rejected some ideas and cast doubt on all my previous assertions as to the level of technology they enjoyed. At the same time, I cast doubt on the methods of manufacture that Egyptologists have asserted were used to build the pyramids and the glorious temples in Egypt. These methods are primitive and include stone and wooden mallets; copper chisels; tube drills and saws; and stone hammers for quarrying, dressing, and sculpting hard igneous rock. Nobody can claim that they know what was in the minds of the ancient Egyptians. All we have are their works: "By their works, ye shall know them."*

This book is about the Egyptians' works, but before understanding the manufacturing and building methods, it is necessary to understand the full scope of each work—exactly what it is we are studying. In the following pages I present another view of ancient Egyptian artifacts: the view of a modern craftsman and engineer made possible through the use and knowledge of modern technology.

After I describe each work, we will examine the methods of con-

*Matthew 7:20.

struction that have been proposed by Egyptologists and discuss some of the arguments against and for considering other methods that are more advanced. It is my sincere wish that the artifacts are respected and understood for what they are. They are priceless treasures and would have astronomical value if produced today using modern tools. Because they are encoded with the knowledge of life on this planet in prehistory and hold a powerful message for future generations, their worth in monetary terms is unfathomable. Their value in raising awareness and dispelling cultural bias, even while short of real answers, cannot be calculated in monetary terms.

1

The Shadows of Luxor

The life of man is a self-evolving circle, which, from a ring imperceptibly small, rushes on all sides outwards to new and larger circles, and that without end.

Ralph Waldo Emerson, *Essay on Circles*

Within the Ramses Hall at Luxor, subtle curves and shaded hues of geometric perfection create an effect that seems designed to mask the real truth about the artifacts. Waiting for millennia for questions that have not been asked, let alone answered, the perfectly crafted granite statues of Ramses II smile and gaze upon each person who enters the hall and tries to come to terms with and grasp the true meaning of the Temple of Amun-Mut-Khonsu at Luxor.

Sometimes referred to as the world's greatest open air museum, the city of Luxor is situated in Upper Egypt, where once stood the ancient city of Thebes, approximately four hundred miles south of Cairo. The temple complexes of Karnak and Amun-Mut-Khonsu stand within the city, and the latter is commonly referred to as the Luxor Temple. Overlooking the Nile River nearby is the Winter Palace where Howard Carter and Lord Canarvon refreshed themselves in the quiet, cool bar. Graceful lateen sails fill and push feluccas on the river, as clouds, haloed by a crimson sun setting in the west, snake like serpents in the evening sky. Monuments, temples, and tombs of the west bank necropolis lie beyond the sails and include the Valley of the Kings, the Valley of the Queens, the Ramesseum, and roads leading to the temples of the north.

If special recognition was given to the billionth visitor to Luxor, I probably missed it by centuries. Millions of tourists go there every year and, in season, jam to capacity the hotels and luxurious floating mansions that cruise the Nile River. Out-of-season accommodations play host to more visitors than a hotel in a normal town would at the height of any tourist season.

In any society, there are geniuses that innovate and make their mark by providing novel and revolutionary iconic images. Within the confines of three dimensions, the subtleties of individual expression allow philosophy, symbolism, and individuality to flow forth into stone, onto canvas, or through the orchestra. This expression guides the chisel and the pen.

◀ Figure 1.1 (opposite). The Ramses Hall at Luxor

Figure 1.2. Bust of Ramses outside the Temple of Luxor

Nowhere in the ancient world is the marriage of art and engineering better expressed than at Luxor in Egypt. The temples have inspired many to write eloquently about the city's magnificent monuments, its history, and the archaeological studies that have yielded untold riches in antiquities. The incredibly significant aspect of the artistic attributes of the numerous statues of Ramses is that it stimulates both the right and the left brain to study how their imposing beauty is not only a symbol of an incredibly gifted ancient culture, but also a symbol of manufacturing engineering that would be considered quite relevant in our modern world.

THE RAMSES CHALLENGE

The ultimate function of art in human evolution is a mystery, but there is no mystery about what art does: it communicates, it evokes, it alters the observer. From the profound power of the Lascaux cave images to

the spattering of Jackson Pollock, art calls to something within the observer. In the case of Luxor and the images of Ramses, the art is highly stylized, symbolic, and uniform. Even to today's observer, it carries a deliberate message of divinity and eternity, of awe and majesty—which must have been so much more powerful to the ancient Egyptians. On another level, to the sculptor who has worked in stone and to the technologist whose job it is to shape adamantine materials, it calls out a question and issues a challenge: "What am I? How did I come to exist? Build another just like me."

It challenges: "Don't just gape in awe and wonder, shake your head, and walk away. Bring me back to life! Know me—who I was and what I was. The only way to do this is to understand what I am and build another! Why am I smiling? Don't think for a minute that I am content sitting here on my pedestal, misunderstood by the droves that have passed by for centuries. There is more here than meets the eye."

The Ramses challenge was issued in ancient Egypt again and again, from Memphis and Cairo to Luxor and Abu Simbel. Exact replicas of Ramses' image were crafted in limestone, sandstone, quartzite, granite, and diorite. Some pieces, such as the Colossi of Memnon, weigh more than 1,000 tons. Other statues at Luxor weigh 600 tons. In fact, just the crowns that top the statues each weigh more than a ton. The statues are massive—a significant challenge to move and, because they are intricately carved, an even more significant challenge to sculpt. What distinguishes the Ramses statues is the iconic imagery of the perfect face. It seems that no matter which of the Ramses statues we look at, the same smiling face gazes through you, into infinity.

In order to accomplish this effect, the ancient sculptors worked to a uniform system of measurement and a design scheme. Just as today we replicate designs using uniform measures and consistent methods of manufacturing, in ancient Egypt there was a system of design, measurement, and manufacture used to create the Ramses statues. We can then ask the question: What was the fundamental scheme that the ancient Egyptians used to create and re-create this iconic image in stone?

In 1986, I visited Memphis, near Saqqara, and gazed down at the

statue of Ramses in the open-air museum. Looking down the length of the statue, it struck me as peculiar that the left and right nostrils were identical mirror images of each other. It is common knowledge that no adult walking the earth has nostrils that are identically shaped. I thought it was noteworthy, but did not follow up and research it further as my focus at the time was on engineering, not art. I was there to study the pyramids and had not planned to visit any temples during my visit. I didn't realize at the time, though, how important my observation would become to my future research.

My interest in the Ramses statues was rekindled when I visited Luxor in November 2004. Though I had been to Egypt four times before and learned to love the Egyptian people for their hospitality and sense of humor, this was my first visit to the temples in Upper Egypt. Words cannot describe my feelings of wonder and awe as I absorbed the temples not only from a philosophical and spiritual aspect but also with my engineer's brain. These temples impressed upon me indelibly that they were incredibly important from an engineering and scientific perspective.

For an engineer or artisan, to walk through the Temple of Luxor is an exercise in humility. Combining the logical, rational, and objective attributes of left-brain functions with the intuitive, subjective, and holistic qualities of the right brain, the experience of seeing these temples is suffused with profound sadness for a civilization that had risen to great heights and then suffered a cyclic decline.

In exploring what is left—the mere skeletons of the Egyptians' achievements—and then going beyond, a veil is lifted to reveal the incredible material loss of a people who created perfectly crafted buildings and statues from the hardest stones known to humankind. This ancient culture accepted the challenge to develop the tools to work glasslike stone—stone that was created by tremendous forces within the earth and spewed, or squeezed, from its fiery belly—to a high order of magnitude, proportion, and exactitude.

Basalt, diorite, and granite yielded to these ancient tools—the quartz crystals abundantly present in the granite and diorite gave way

to the application of ancient technology now lost. Perfection was the goal, and the ancient Egyptians' stone-working craft, as we shall see, was perfected to the extent that exactness was achieved.

Even if our mind is not normally turned toward philosophy, a visit to Egypt soon finds our thoughts seeking refuge in ruminations of wonder at what once was and what could have (or must have) been had there not been an interruption. From the perspective of a philosopher, the mortality of physical existence is reinforced. We slowly realize that civilizations are like the human body—they have a life cycle. This is a discomforting thought for those who are faced with the implications of what Egypt's accomplishments mean. We become comfortable to the extent that we can master our environment, but eventually we all must yield to the ultimate master. The natural cycles of the universe and their concomitant forces of nature unleash death and destruction with as much indifference and impartiality as they provide what is necessary for life to exist.

The Temple of Luxor holds a message for our civilization—one that reaches across millennia through the ravages of time, and, though shaken, crippled, and on its knees, it implores us to pay attention.

I was with a delightful, eclectic group of people on a tour of Egypt in November of 2004. The tour was arranged by Andrea Mikana-Pinkham of Body Mind Spirit Journeys, and presenting on the journey were my good friends Stephen Mehler and David Hatcher Childress. A broad range of people from various backgrounds, including engineers, a pilot, salespeople, a doctor, a nurse, a minister, and, from Florida, a sassy barmaid with an infectious laugh, milled around the bus every morning in anticipation of another great day in the field. Everybody was having a wonderful time, and we all had one thing in common: a deep respect for the Egyptian culture and its monuments. Good humor and jokes flew around the bus like the swallows that swirl around the Great Pyramid at dawn.

Before 2004, I had not paid much attention to the temples in southern Egypt. Instead, I focused my attention on the pyramids and what I considered to be their more technical engineering attributes. As a part

of this tour, I was fascinated by the story given by the Egyptologist tour guide, but I was not so fascinated that when an object caught my attention, I refused to wander off to do some exploring on my own.

When you are part of a tour group, your visits to temples are strictly controlled. Generally, the tour operator takes you to Luxor at a time when it is the most visually stimulating: at night, when the temple is lit up with carefully designed and directed lighting. When you walk among the massive columns that reach to the sky like giant redwoods, the chattering of numerous tour guides fades as the power of the temple imposes its own majesty and voice onto your consciousness. This effect became more meaningful to me later, as my interest peaked and I began to learn more about the symbolic and philosophical interpretations that the temple has evoked from the hearts and minds of other researchers.

THE SECRETS OF THE CROWN

While our guide explained the meaning behind the intricately carved reliefs on the walls of the temples, several pieces of granite that were positioned in front of statues in the Ramses Hall—the first hall visitors enter after passing through the first pylon—managed to catch my attention. The explanations of the symbols on the walls suddenly lost their interest to me. Commanding my attention now were objects that appealed to a part of my nature that had been developed over many years of training and experience in manufacturing.

I recognized the granite pieces' faintly illuminated shapes as the cone-shaped crown of Upper Egypt: the Hedjet. Depicted as a white conical headdress in Egyptian art, images of the crown are found on the Narmer Palette and, famously, on the gold statue of the boy-king Tutankhamen. Another crown found in the Ramses Hall is the Pschent: a combination of the Red Crown of Lower Egypt and the White Crown that symbolizes the unification of the two Egypts. (See figure 1.3.)

During this visit, I was able to examine them only visually and feel their smooth surfaces with my hand, but I was struck by their perfection of form, and I could not detect any deviation from a perfectly crafted

Figure 1.3. The Hedjet (front) with Pschent (back)

contour. Throughout the course of my career, my hands have run across many different machined contours in order to find surface imperfections—and my contact with these Egyptian pieces seemed no different from my previous contact with objects that had been removed from a precision machining center. Except for some minor abrasions (presumably the result of the crowns falling to the ground) there were no pits or ripples or depressions in the compound curved surface. I felt only a flowing, exact surface that seemed as smooth as though it had been spun on a lathe. Because of its geometry, however, it would have been impossible to craft these crowns in such a manner. Along the length and width of each, the surface followed simple arcs that obviously were the result of careful deliberation in concept, design, and manufacture. From a cursory examination, it seemed clear to me that this result demanded adherence to geometry and precision in the manufacturing process.

This impression gnawed at me for a year, until I finally awoke to the

realization that I had to go back and study them further. My opportunity to examine them again wouldn't come until February 2006, when I went to Egypt with John Anthony West on one of his Magical Egypt tours.

My main interest in going with West was to learn more about R. A. Schwaller de Lubicz, who had spent fifteen years at Luxor studying Amun-Mut-Khonsu and had concluded that it was built using a system incorporating precise measures that were a deliberate representation of the universe and man. Amun-Mut-Khonsu is, according to Schwaller de Lubicz, a material expression of cosmic correspondences. His magnum opus was translated into English in two volumes titled *The Temple of Man*.[1] It is considered a difficult work to understand, and West was one of the few people in the English-speaking world who knew Schwaller de Lubicz, supported his conclusions, and wrote about him in his own book *Serpent in the Sky*.[2] A more recent treatment of Schwaller de Lubicz's work is *The Spiritual Technology of Ancient Egypt,* by Edward Malkowski.[3]

Before traveling with West, I bought a Canon digital Rebel XT 8-megapixel camera, and I took my laptop with me on the journey. Had I known at the time what my camera would reveal to me, I would have taken a good tripod too. Regardless, there is not much time for careful photography while on a tour because of time constraints, so it was more a matter of taking typical tourist photos—but doing so while striving, as best as circumstances allowed, to capture centered images of the crowns so that later I could evaluate their symmetry on the computer.

Because our visit to the Temple of Luxor was at night, I could not take the photographs I wanted of the crowns, so I photographed the Ramses statues and the bust near the obelisk outside as well as the obelisk itself, all the while attempting to keep the images square and the axis of the camera in line with the central axis of each object I was photographing.

The next day, after our excursion to Denderah and Abydos, I had the bus drop me off at the temple instead of the hotel in order to photograph the crowns in daylight. At this time, I was able to get better photographs just before dusk—the sun had barely disappeared behind the

wall of the Temple, so it did not cast any sharp shadows. This allowed for a very evenly lighted shot that minimized distortions of the symmetries of the objects I wanted to measure.

To a certain degree, my session was successful, and I was able to ascertain with some certainty that these crowns spoke an untold story. I took a digital image of one of the crowns and loaded it into my graphics program. I then duplicated the image and made a transparency of it so that I could compare opposite sides to determine if they were symmetrical. I discovered that they were—to a remarkable degree of accuracy. (See figures 1.4–1.6.)

This symmetry, of course, compelled me to ponder how it was accomplished. In order to reverse engineer and duplicate an object, we must determine precisely the geometry encoded in its design. A few clicks of the mouse later, I had an answer to at least part of the geometry.

Figure 1.4. The first Hedjet original image

Figure 1.5. The first Hedjet original image and a reverse transparency that is slightly off center was created so that the shadow line can be seen.

Figure 1.6. The first Hedjet original image and a reverse transparency on center. Note the symmetry between both sides.

Figure 1.7. Hedjet symmetry with identical radii

Figure 1.7 is a photograph of the front view of the Hedjet. It was taken as close to the center axis as possible so that the symmetry of the piece could be measured. As it turns out, we can determine fairly conclusively that the crown was designed and crafted to incorporate a true radius of the same dimension on both the left and right sides when the Hedjet is viewed from the front.

I analyzed another crown in the hall in the same way (see figures 1.8 through 1.10), and though it blends with the head of the pharaoh, it is crafted with a similar exact geometry.

On the first Hedjet, toward the top of the crown, the contour of the granite starts to move away from a true radius and follows another contour. We could determine exactly what that contour is if the crown was intact, but instead we must examine other crowns that do not have their tops broken off.

The next question that sprang to my mind was whether the radius

Figure 1.8. The second Hedjet symmetry with identical radii

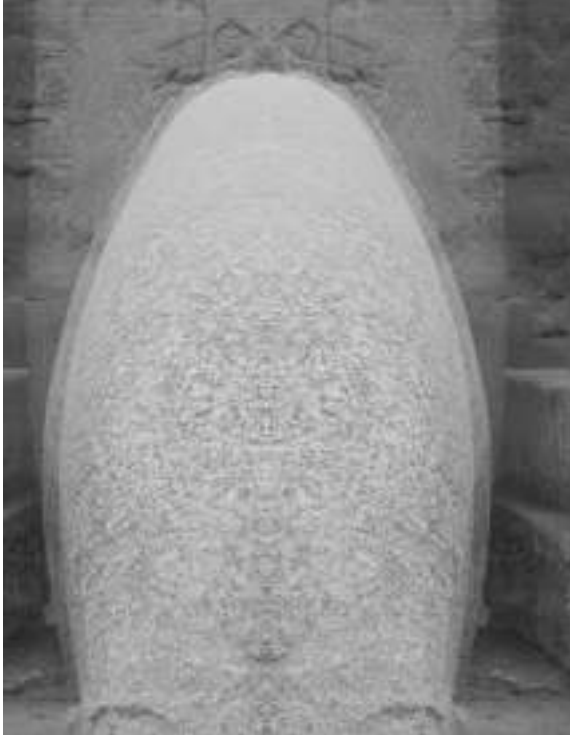


Figure 1.9. The second Hedjet original image and a reverse transparency that is slightly off center

Figure 1.10. The second Hedjet original image and a reverse transparency on center. Note the symmetry between both sides.

was spun around a central axis—similar to the geometry on a bowling pin. Unfortunately, the answer to this question would take more time, because I had not taken any photographs of the Hedjet from the side—in fact, the question had not occurred to me until I was back at home, studying the photographs on my computer. When I was in the field, I was looking for symmetry and knew that the front and back were not symmetrical, so I didn't bother taking any photographs from that angle.

I was a bit chagrined that I didn't have the presence of mind to take those photographs, but I continued working with the ones I did have and determined that I absolutely had to return to Egypt and finish what I had started—or at least I had to take this mode of inquiry to the next level within my reach. I believed that at Luxor I had discovered a quality and precision of manufacturing granite that rivaled or surpassed what I had studied near the pyramids in Lower Egypt.

Because I had already taken two weeks of vacation, Judd Peck, the CEO of Danville Metal Stamping, my employer, was a bit perplexed when I asked for more time and told him that I needed to go back to Egypt when I had returned only a couple of weeks earlier. To convince him that the trip was legitimate, I shared with him what I had discovered in my many photographs.

Judd Peck is the president and CEO of a gas turbine engine manufacturing company with 410 employees. He is also a member of the Illinois Bar and a well-respected attorney in the community with impeccable judgment and common sense. After viewing the photographs for thirty minutes, he nodded and said, "I see what you mean."

The next day, I received a surprise: Judd came to my office and asked me if I was traveling alone to Egypt. What he had seen must have inspired him—he asked if he could tag along and carry my tripod. Of course, I was delighted to have him as a traveling companion, and in the last part of April through the first part of May, we went to Luxor to continue taking more tourist photographs.

As it happens, the quality department at Danville Metal Stamping had recently reviewed some new technology called Capture 3D. This

uses digital photography to take a stereo image of a contoured surface and then imports the images into proprietary software. The accuracy of the surface is compared to a computer model design and the imperfections are highlighted. In the world of *metrology*—the science of measurement—it is a relatively new technology, but one that yields reliable results. Judd and I were part of a panel that reviewed the technology and, in doing so, learned about some of the other work that had been performed by the company, such as digitizing and creating computer replicas of the statues on the Charles Bridge in Prague, in the Czech Republic.

With that resource in mind, I gathered some more equipment to assist me in my task: a sturdy Manfrotto tripod, a right-angle viewer, a telephoto zoom lens with macro focusing, and a wide-angle lens. Along with my digital camera, I brought to Egypt a film camera that accepted the same lenses.

The first day in Luxor we visited the Temple of Amun-Mut-Khonsu and spent about six hours there with very few tourists present. On this trip I discovered that it is best to experience the temples of Egypt in silence. I'm not sure how the ancients experienced these structures, but emanating from them—seemingly inversely proportional to the level of ambient noise—is a profound majesty. The hum of the city was an omnipresent background during my viewing, but within the colonnades and sanctuary of the temple itself, city sounds faded to insignificance and all was stillness and quiet. Similarly, on another trip that Judd and I took to Denderah, we were lucky enough to be there when all the tour buses had left. We spent several hours enjoying that temple in silence.

I found myself absorbed in thought as I went to work taking a set of photographs of artifacts that for months had consumed my mind with their overwhelming uniqueness. My thoughts turned to the recent Internet competition for the new list of Wonders of the World. I thought it was ironic that the Wonders of the World that I framed in my camera viewfinder on this visit were not even mentioned. In terms of beauty and the knowledge and skill they illustrated, the statues of Ramses II at Luxor and other locations in Egypt surpassed all other

competition candidates in terms of advanced geometry and complex manufacturing precision in one of the hardest-to-work materials known to mankind. As I hope to demonstrate here, the statues of Ramses challenge the Giza pyramids themselves as the most perfectly engineered artifacts of ancient Egypt—and perhaps of human history.

The polished glint of granite again compelled me to run my hand over its smooth, but now familiar contour. Again, I marveled at the feat of engineering and the fact that the granite crowns were originally placed on top of the heads of the Ramses statues that populate the precincts of the temple. Some of these statues are 40 feet tall, beyond the scrutiny of earthbound observers, yet the creators of these wonders had seen fit to place upon them crowns that were carved with, what I suspected from my examination so far, extraordinary exactitude.

Setting to work with my camera, I began to take more photographs, and I captured the images I failed to get the last time I was in Egypt. This time, my camera was firmly mounted on a tripod stand with a remote shutter-release button.

When I took the side-view photo of the Hedjet depicted in figure 1.7, I was unable to get a perfect right-angle view of the front because of barriers in the vicinity: A pillar was close to one side, and another crown was close to the other, but I was able to set the tripod to the side and obtain a shot at about 75 degrees. Upon review of the image, the answer to my previous question was answered: the side view of the Hedjet revealed that the contour on the front was also a true radius. Interestingly, though, at this angle, the radius had reduced in size by about 15 percent. (See figure 1.11; Radius B is 85 percent of Radius A.) Moreover, as the radius transitioned from the side to the front, the center point of the radius moved down slightly.

Fortunately, there were other crowns to study, and I set up my camera to focus on another on the west side of the hall—one of three crowns that had been placed in front of three statues positioned between the columns. In taking the series of photographs shown in figure 1.12, I attached a compass to the tripod and moved the camera around the crown in 45 degree increments. When I analyzed the results in the com-

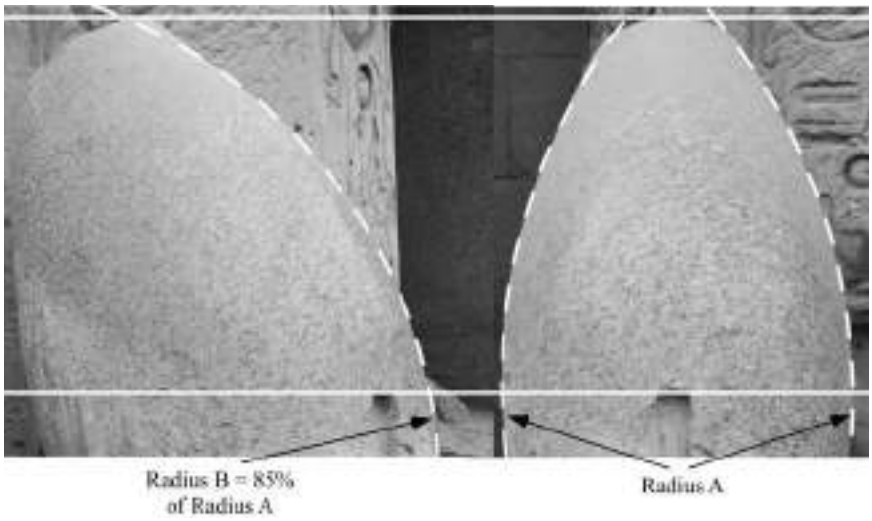


Figure 1.11. The Hedjet, side and front

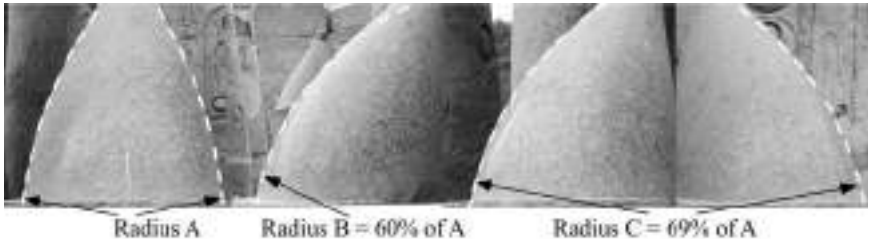


Figure 1.12. Front, side, and angled view of a crown

puter, I was astounded at the amazing accomplishment of these ancient craftsmen and, more important, of the fact that they saw fit to design these crowns to incorporate such a difficult and complicated work of art and engineering. From a conceptual and design standpoint, designing the crowns in this way would be a fairly straightforward task, but did the designer have any idea what he was asking of the craftsperson who would cut his design into stone? He might have said to his friends, "Hey, want to see what I did to drive the guys in the shop crazy? I just made the design of the crown exponentially more difficult to manufacture."

To accomplish such cutting today in one of the hardest natural

materials known and with such a high order of precision would require specialized equipment and careful planning. What tools did the ancient Egyptian artists and engineers possess? Were the tools they used as sophisticated as the products they created? What I discovered was not the product of a simple mind. The crowns are sophisticated products with difficult and exact surfaces that would challenge any craftsman, even one who is trained in today's methods and equipped with today's tools.

The next order of business was to take a photograph from the top of a crown looking down. My tripod was built so that I could extend a rod horizontally, but I discovered that the legs would not reach high enough above the crown to allow me to use it. This meant I had to hold the camera at arm's length while hoping that the resulting photograph would be useful.

The results were tantalizing enough to allow me to speculate that I could confirm more remarkable geometry if I could take a shot along the central axis of the crown, with all the features in full view. As it was, I had to be satisfied with what I had already obtained, because there was no way I could improve on the situation without building a platform. Preferably—and perhaps the Supreme Council of Antiquities will see fit to fund this one of these days—an engineering company should take a crown and fully digitize its geometry on a coordinate measuring machine or by some other technology accepted by the National Institute of Standards and Technology, formerly the National Bureau of Standards.

Nevertheless—imperfect shooting conditions aside—the results are noteworthy. From the top looking down, the crown at the widest point forms an almost full circle. It is interesting to note that in this view, the center point of the radius is off center relative to the top of the crown. This indicates that even though the upper right quadrant of the crown reveals less of the surface than the lower right quadrant, and the dotted line is theoretically touching the surface higher on the crown in the upper quadrants than the lower quadrants, there is still an almost perfect circle. This can mean only one thing that is extremely important

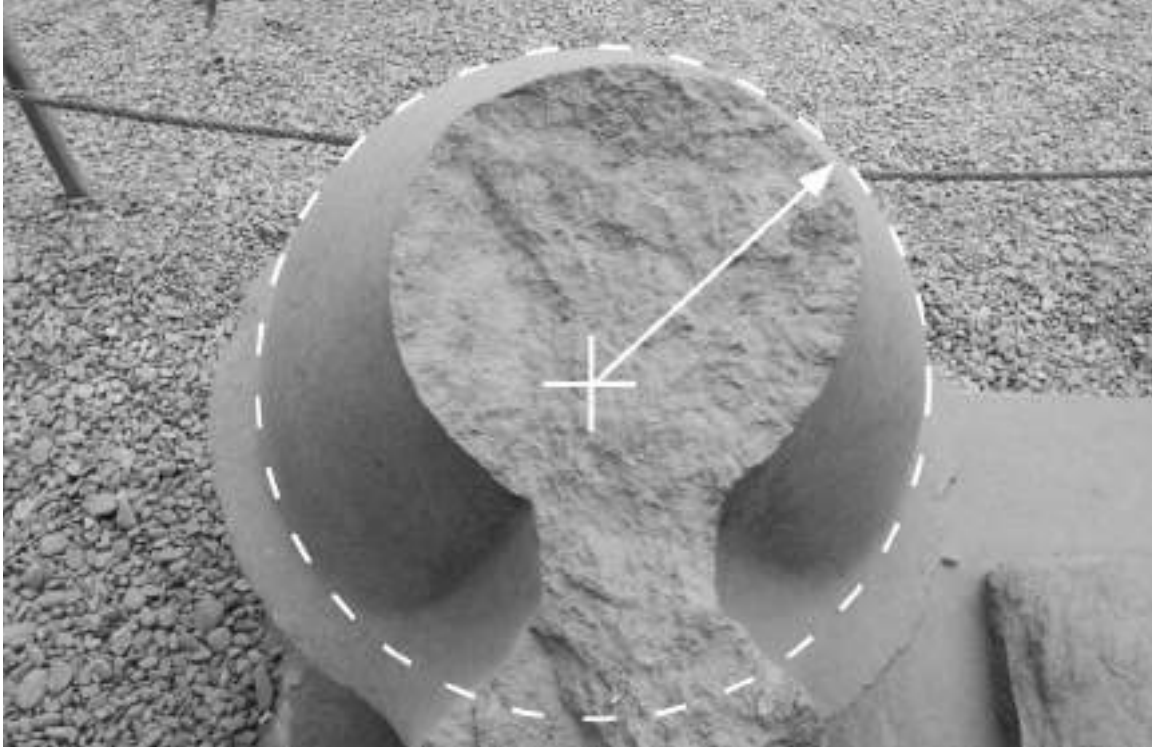


Figure 1.13. Looking down on the circle geometry of the crown

to an understanding of the sophistication of the designers and carvers of this artifact: to rotate a round object and observe the same radius at a different orientation indicates that what is being observed is a sphere and that this basic shape was used to design the crown.

To illustrate this: if you have a tulip-shaped wine glass in your cabinet, examine its shape as you move it around in your hand. Essentially, you are examining surface geometry that is similar to that of these Hedjet of Upper Egypt.

The wine glass is not exactly the same as the Hedjet, but it has the basic elements that contribute to the Hedjet's shape: a large radius blending with a smaller radius at the bottom. The tilted glass illustrates how a smaller radius could be evident in the Hedjet and supports the idea that the Hedjet approximated a sphere—at least toward the bottom of the crown.

If we look down on the wine glass, we can see that when it is tipped at an angle, the results are similar to those in the photograph looking down from the top of the Hedjet.

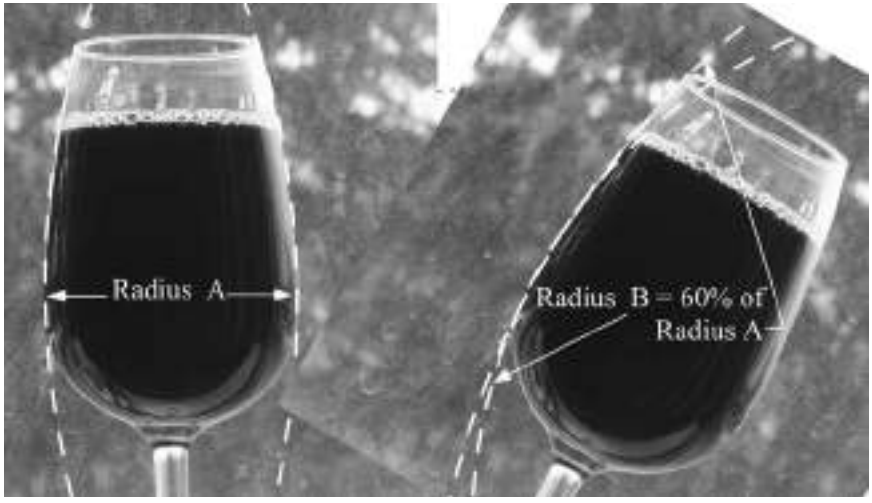


Figure 1.14. Geometry of a wine glass

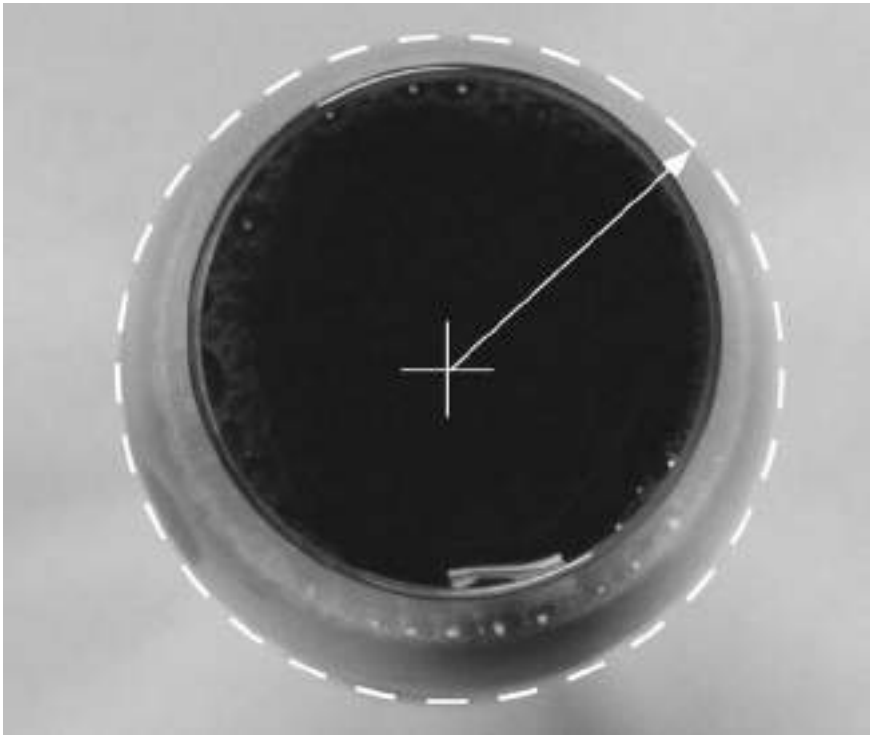


Figure 1.15. Looking down on the wine glass

From figure 1.15, then, it is clear that the geometry of the Hedjet was a sphere at the base and a sphere (the top knot) at the top. Between these two principle cosmic shapes, an infinite number of spheres were incorporated to form a perfectly smooth and precise surface. To understand how this works, we must examine an intact, unbroken crown that has escaped the ravages of time and abuse. One of the finest examples is found on the head of a statue at Karnak.

The upper profile is a circle that is a cross section of a blend radius between the top knot (a sphere) and the body of the crown. The bottom profile is where the White Crown portion blends with the Red Crown portion, and where the two meet is a precise blend radius, as figure 1.16 illustrates.

In figure 1.16, the blend radius of the White Crown (Hedjet) near the top knot, identified as A, and the surface geometry of the Red Crown (Deshret) identified as B, are profiles between which the surface

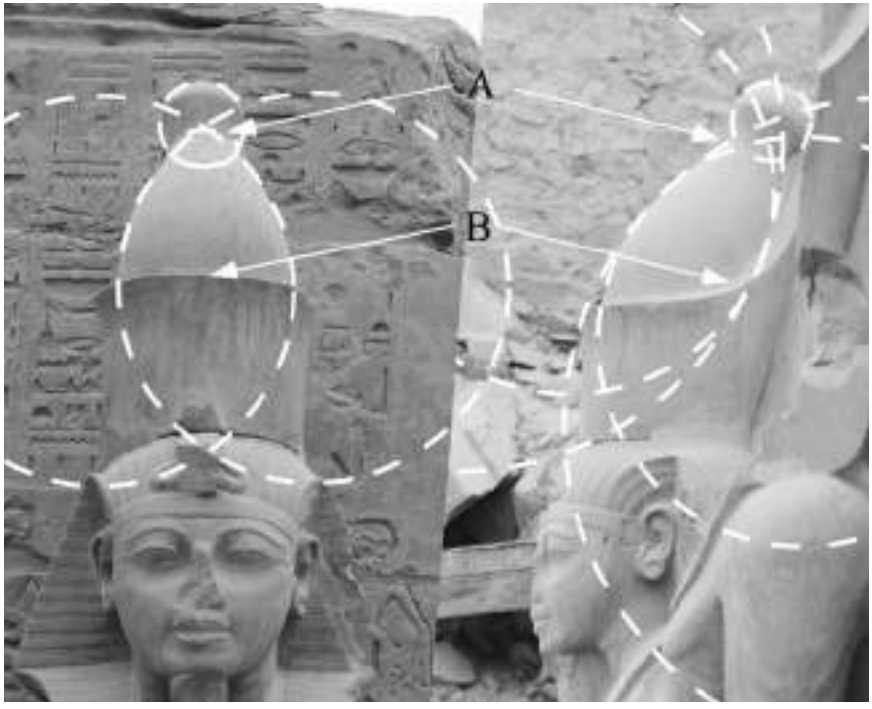


Figure 1.16. Front (left) and side (right) views of a Pschent at the Temple of Karnak

of the Hedjet is smoothly rotated around the central axis of the crown. The images indicate that the radial profile of this surface changes in size as it sweeps around to the front—constantly reducing in dimension. After examining figure 1.16, we might ask if the geometry of the White Crown is fashioned after the shape of a bowling pin, for which the same radius profile is turned, as on a lathe or a potter's wheel. As it turns out, this might indeed be the case. In figure 1.17, a series of spheres are drawn

Figure 1.17. The spherical nature of the Hedjet part of the Pschent

to fit within arcs based on the actual shape of the front of the Pschent, then are mirrored to create the theoretical opposite side at the back.

The best description of the Hedjet is that it is similar to a bowling pin that is tilted on an angle and that when it's combined with the Deshret it adopts precise geometries that make it more complicated to manufacture than a shape that could be produced on a lathe.

This is easily said, but how did they accomplish this in hard granite? To understand what the ancient Egyptians were able to accomplish, it would help to discuss where art becomes secondary to engineering. Art does not require the degree of exactitude found in these crowns to convey a message or evoke an emotion. Art, in general, is thought of—and usually is—outside of architecture. It is free-flowing, intuitive, and unconstrained by what are typically regarded as left-brain functions (e.g., the logical, disciplined application of precise geometry and mathematics). To understand this, we can look at a modern artifact that was created by modern tools to represent Ramses and that finds its way into the homes of those who have traveled to Egypt or who shop online for Egyptian iconic statues.

Figure 1.18 shows a statue that is obviously the work of a sculptor. As we can gather from the photograph, there was no expectation

Figure 1.18. Souvenir statue of Ramses

of precision in the manufacture of the object, and none was achieved. That wasn't the objective for this object, and tools that would ensure precision were not employed in its creation. Bruno Walter, the famous orchestral conductor, said, "By concentrating on precision, one arrives at technique, but by concentrating on technique, one does not arrive at precision."[4] A corollary to this is that in order to achieve precision, we have to concentrate on precision. There is no getting around the exactness we find in the granite crowns. They were not the result of random coincidence, but the application of tools and techniques that were far more advanced than the tools and techniques that are currently attributed to the ancient Egyptians.

To find further illustration, we can examine briefly craftwork as it has been applied for many years. To the uninitiated, manufacturing plants might appear as behemoths that spew forth smoke and a stream of modern products. To the initiated, however, they are places where a very specialized subset of society and culture exists. There, institutional knowledge is passed from generation to generation and formal and informal hierarchies are established to create order and an understanding of how things should work. A casual visitor cannot recognize this. How could they? It may take some time spent in a manufacturing plant to learn that there are different skill levels and knowledge associated with those skills.

Outside of manufacturing, *precision* has a different meaning. We may appreciate the precision of our cars and cell phones, though we are oblivious to the technologies that are employed in their creation. As products have flowed out of manufacturing plants to consumers these past fifty years, they have transformed the world. What we enjoy today is the result of a manufacturing evolution focused on meticulousness and consistency intended to eliminate variables in the manufacturing process.

If we compare an automobile built fifty years ago to one built today, the changes are startling. Even if we look back thirty years to the mid-seventies and examine the fit and finish of our cars, we can see a huge difference in the precision of how parts fit together—the gap between a car door and the body, for instance.

Another difference we see in consumer products is the rounding and stretching of once angular body shapes to flowing curves and organic shapes. Notice how lights with oval, shaped contours follow three-dimensional curves to blend smoothly with the body of a car. All of these qualities are made possible by the introduction of new technologies into manufacturing that allow artistic engineering design modeled in a computer to transfer to machines that create dies with an exactness that at one time would have been either too costly or downright impossible to accomplish.

Because I have been involved in and witnessed these changes over the years, I have become familiar with definite surfaces and what was—and is—involved in creating them. Techniques have evolved from creating wooden or plastic models, and then tracing the models in machines in order to duplicate their shapes in hard steel to using computer models to generate instructions for machines to follow. I have run my hands over countless surfaces to check for irregularities and imperfections. The elimination of these imperfections has progressed over the years to what we have today. We now enjoy different kinds of aircraft, cars, refrigerators, televisions, and cell phones. They have a different look and a different "feel" to them than products of fifty years ago.

Figure 1.19 is the punch part of a die that creates the inner hub for an aircraft engine assembly. The hub starts out as flat sheet stock and is formed around the punch to create the shape seen in the figure. Because it is a round and concentric object, its geometry is not as complex as those of the Egyptian crowns. The rounded end of the punch is an ellipsoid shape. Figure 1.19 illustrates the minimum number of radii needed to create the ellipsoid as well as the elliptical shape itself superimposed on the tool. The similarities between the die and the crowns lie in the precision and the "feel" of the surfaces. Also common to both are the concentric circles that comprise their geometry. To have made this piece fifty years ago, we would have used a template mounted to a rail at the back of the lathe along which a stylus traveled to guide the tool that cut the material. Today, such shapes are routinely described in a computer program and downloaded into the lathe's computer memory for execution.

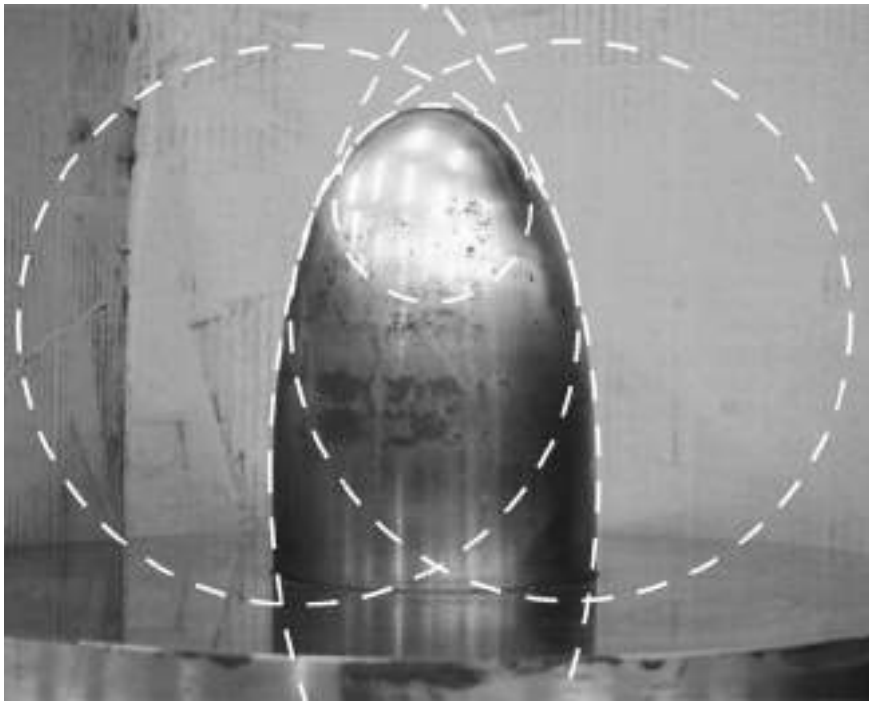


Figure 1.19. Part of a tail cone die used to create the inner hub of an aircraft engine

With the introduction of the ellipsoid, we can now look at the crowns in a different way. By drawing perfect ellipses and superimposing them on the photographs of the crowns, it becomes clear that the ancient Egyptians used this geometry, rather than a simple radius, in their design of the crowns.

The implications of finding such overwhelming evidence of sophisticated geometry can be argued by scholars into the future. Suffice it to say that elliptical geometry is not generally discussed in association with Egyptian geometry. For the purposes of the discussion here, though, I am more interested in how the geometry was crafted with such exactness in hard granite. This, then, is why I believe the crowns at Luxor are so important. They do not have the "feel" of products made by hand. They do not have the "feel" or the geometry of products made with simple and primitive machines or tools. If you travel to Luxor and run your hands over their surfaces of the crowns, you can compare

Figure 1.20. Karnak ellipse 1

Figure 1.21. Karnak ellipse 2

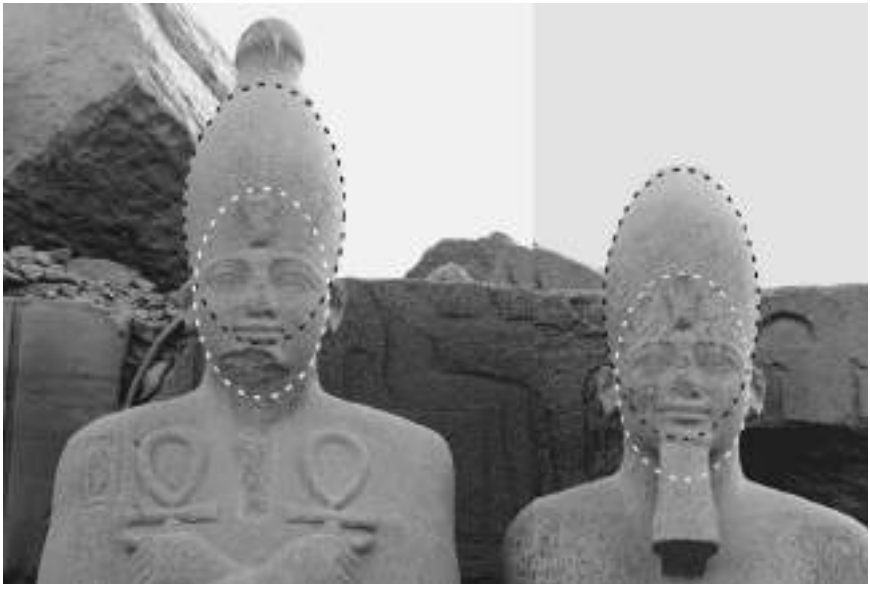


Figure 1.22. Karnak ellipse 3

Figure 1.23. Karnak ellipse 4

Figure 1.24. Ellipse of the first Hedjet of Ramses at Luxor

Figure 1.25. Ellipse of the second Hedjet of Ramses at Luxor

Figure 1.26. Ellipse of the third Hedjet of Ramses at Luxor

the "feel" of their smooth contours to those of your own car. These objects have the same kind of definitiveness and meticulousness as the dies that formed the body of your car. While you are online purchasing your ticket to Luxor, pick up your computer mouse and notice that it is crafted with compound radial surfaces. Contours that transition from large to small radii are products of precisely machined molds. We take

Figure 1.27. Ellipse of the fourth Hedjet of Ramses at Luxor. Photograph of the seated statues of Ramses in Ramses Hall, taken with a telephoto lens from the Sharia al-Corniche, the road that passes between the temple and the River Nile.

Figure 1.28. Ellipse of the fifth Hedjet of Ramses at Luxor. *Note:* Both figures 1.27 and 1.28 were taken at a distance in order to minimize the tilt of the camera from the horizontal plane. Even then, because of the height of the statues, the camera had to be tilted upward in order to capture the image.

them for granted, but there is an unseen world behind their creation.

And yet supposedly the crowns were crafted more than three thousand years ago. How could this be? How did the ancient Egyptians accomplish this? Why even conceive of such products if there were no tools to accomplish their making? What system of measure did they use?

The ancient Egyptians were known to use grids in their designs.[5] This indicates that they would have used what we know as Cartesian

geometry, though undoubtedly they would have called it something different. Nonetheless, being in the same world as us, we can be assured that they were working in three-dimensional space and had identified the orthogonal axes of orientation that we know as *x-y-z*. They probably also had developed the concept of pitch and yaw, the rotational axes that are associated with navigation within three-dimensional space. For these constructs, too, the ancient Egyptians would more than likely have had their own labels.

When fixing a Cartesian view to a crown that approximates the crown's orientation on the Ramses head, we see that its contours are not simple lathed shapes, but instead, they change continuously by degrees while conforming to a shape that, when measured at any angle around the object, is a true radius or combination of blended radii that form an ellipsoid. The sweeping curved surface was not the result of a random burst of artistic whimsy and a flourish with the chisel. It was a decidedly disciplined, orderly application of a design with tools that have not

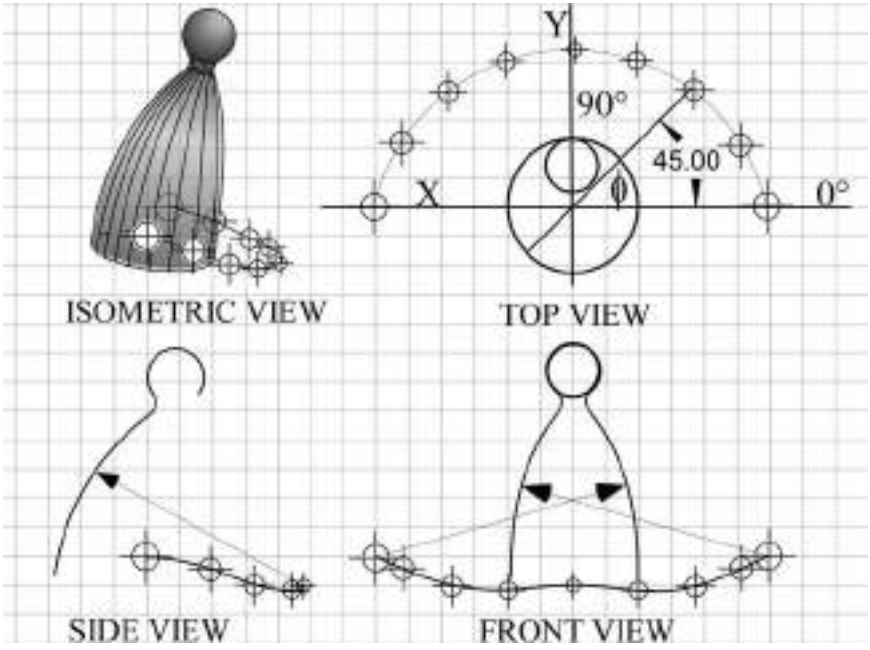


Figure 1.29. Inferred center points of radii around each crown

yet been found in the archaeological record, but which were built to achieve the precise removal of material.

The design and precise geometry that was crafted into Ramses' crown is a symbol of a society that was disciplined in precision engineering and craft. The pieces could not have been created without the aid of some kind of mechanical device that guided the tool along a prescribed contour. Neither was this mechanical device a simple machine. Figures 1.29 and 1.30 illustrate a path of the center point of an arc extrapolated from the geometry of the crown. If the designers were to convey to the engineers or craftsmen what they wanted, drawings similar to figure 1.29 and figure 1.30 may have been used. The design is one thing, but devising from the drawing a means of cutting the design into granite—with the exactitude noted in the photographs and transmitted through the palms of my hands to my brain as I felt each surface—is entirely another matter. Creating such an object today using modern computers, software, and computer numerical controlled (CNC) machines would present some significant challenges, to be sure—but not as much head scratching would be involved today as there would have been forty-nine years ago, when I first entered the manufacturing trade as a young apprentice. Applying the tools of fifty years ago to the Ramses challenge would severely tax craftsmen skilled in manufacturing, and the tools and instruments necessary to ensure such precise geometry would not even be in a sculptor's toolbox.

If we consider the use of a hand-operated device that allowed a tool to pivot around its center point, thereby striking an arc from the top knot of the crowns to the base of the granite, geometry dictates that as the tool sweeps along an arc, its path would be constrained such that precision is assured. The tool would need to be robust enough that it would not wander from its course. After accomplishing one pass, the pivot point of the tool would need to move along an orbital path around the granite. We can see from figure 1.12 (see p. 23) that the center point of the arc is actually lower at 45 degrees than it is at 90 degrees. This indicates that the center point's orbit around the crown may describe not a simple arc, but a wave. To explain this further, assume that the side

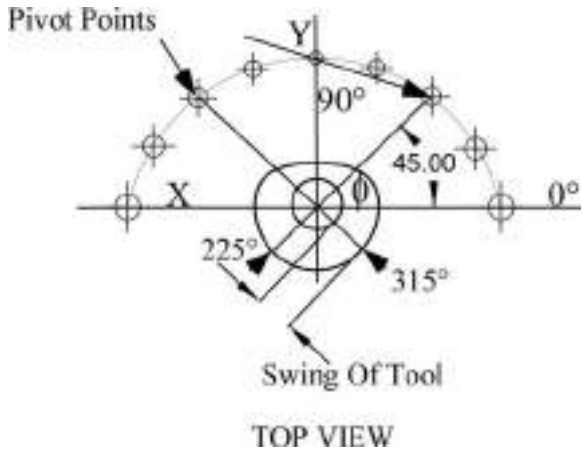


Figure 1.30. Directing the tool

view of the crown describes a contour that is at 270 degrees of a circle. Using polar coordinates (described in figure 1.30), we start the tool at 0 degrees and move it clockwise around the crown. At 315 degrees, the center point of the arc is lower than it is at 270 degrees, and the same applies at 225 degrees. As the tool is swung along its arc, the axis along which it moves follows an unwavering arc with precision between the tangency point of the blend radius at the top knot and the base, while the radius of the arc from 0 to 270 degrees gets incrementally smaller. Then, from 270 to 180 degrees, it starts to get larger again at the same precise increments that it did on the other side.

The challenges involved in creating the Ramses crown would be significant in any era. Fifty years ago we might question why we should devise such complex machines to create a crown that is going to sit atop a statue that is 40 feet in the air and far removed from close inspection. In today's world, if we had to create a dozen or so of these crowns and they all followed the same general design scheme—with some variations—it would be more efficient to create a computer model and generate a CNC program to automatically machine the piece. Then we would need to find a machine large enough to cut these crowns on—because they are not small by any means.

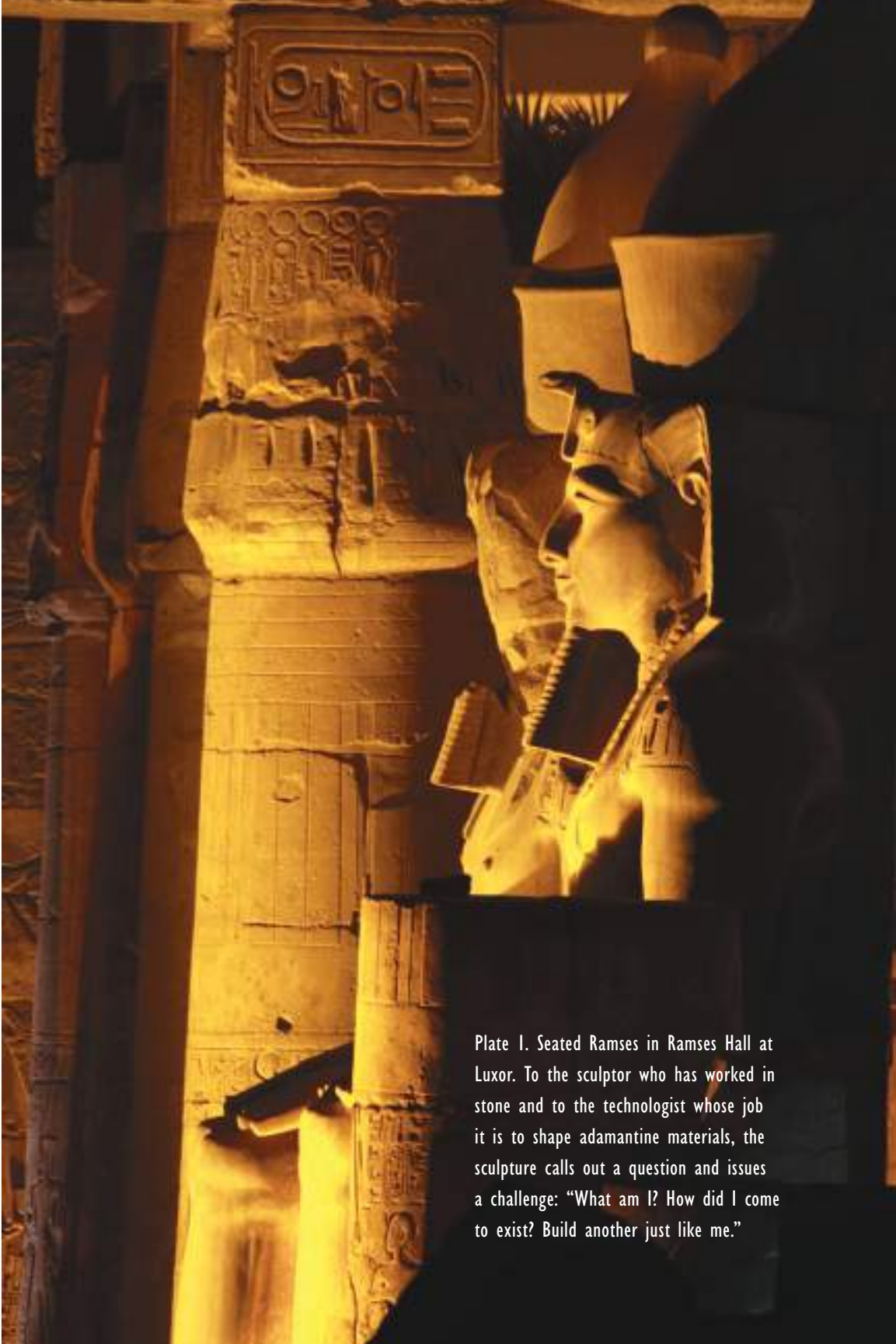


Plate I. Seated Ramses in Ramses Hall at Luxor. To the sculptor who has worked in stone and to the technologist whose job it is to shape adamantine materials, the sculpture calls out a question and issues a challenge: "What am I? How did I come to exist? Build another just like me."

Plate 2. Along the length and width of each crown, the surface follows simple arcs, a result of careful deliberation in concept, design, and manufacture.

Plate 3. The scale of the Egyptians' accomplishment is no better described than Ramses looking down on a throng of visitors to the temple.

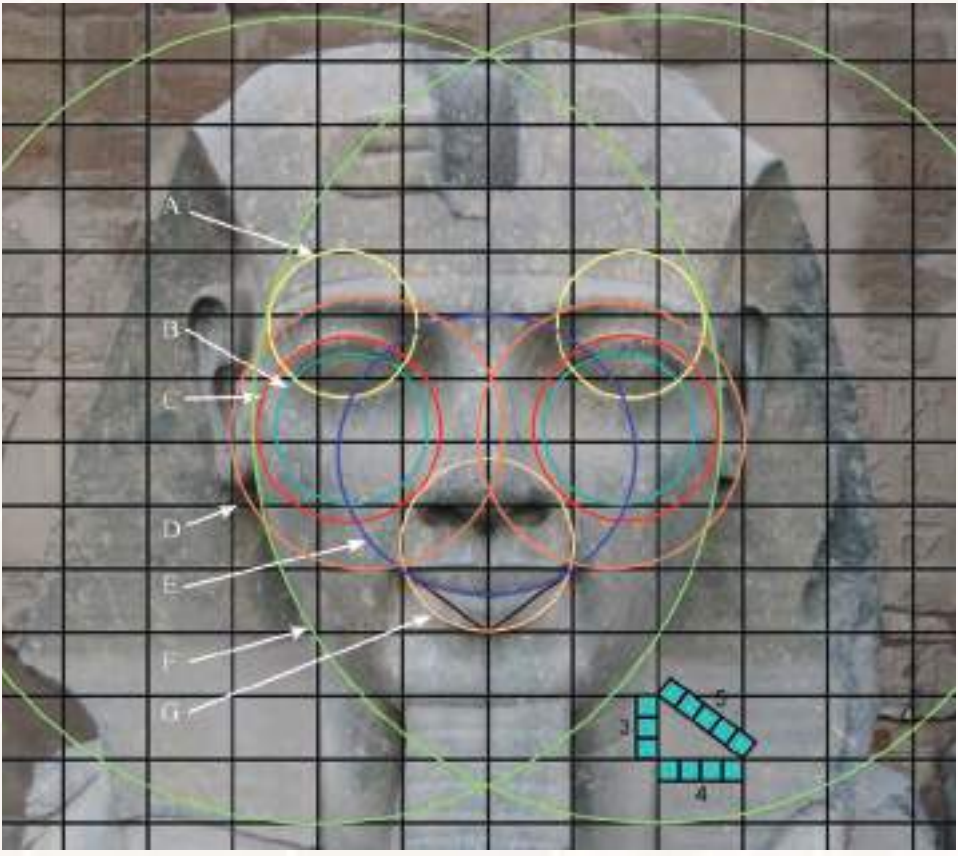


Plate 4. Ramses geometry speaks of unambiguous quality and exactness.

Plate 5. A happy coincidence and interplay between ancient geometry and art

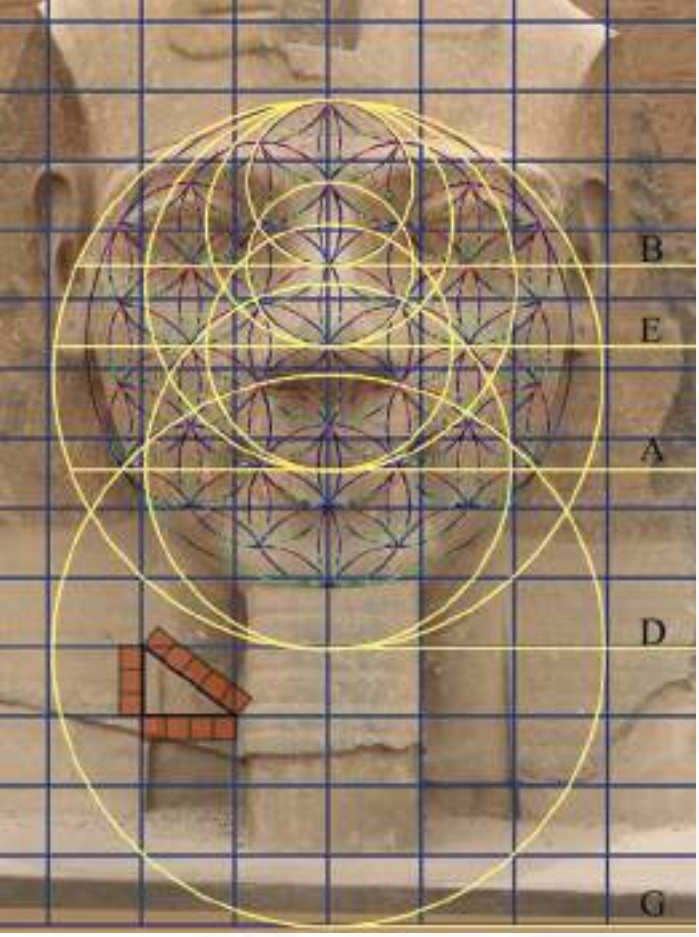
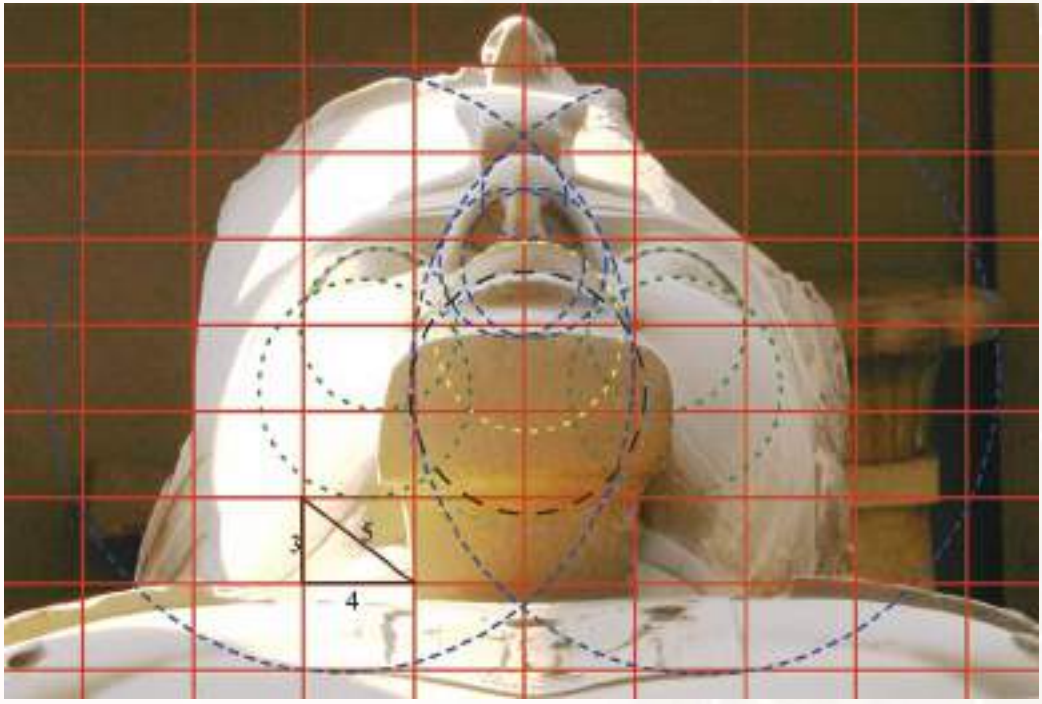


Plate 6. Divine harmony and iconic art combine in a symphony cut into stone.

Plate 7. Ramses at Memphis provides further evidence of uncompromising precision with ancient three-dimensional profiling.



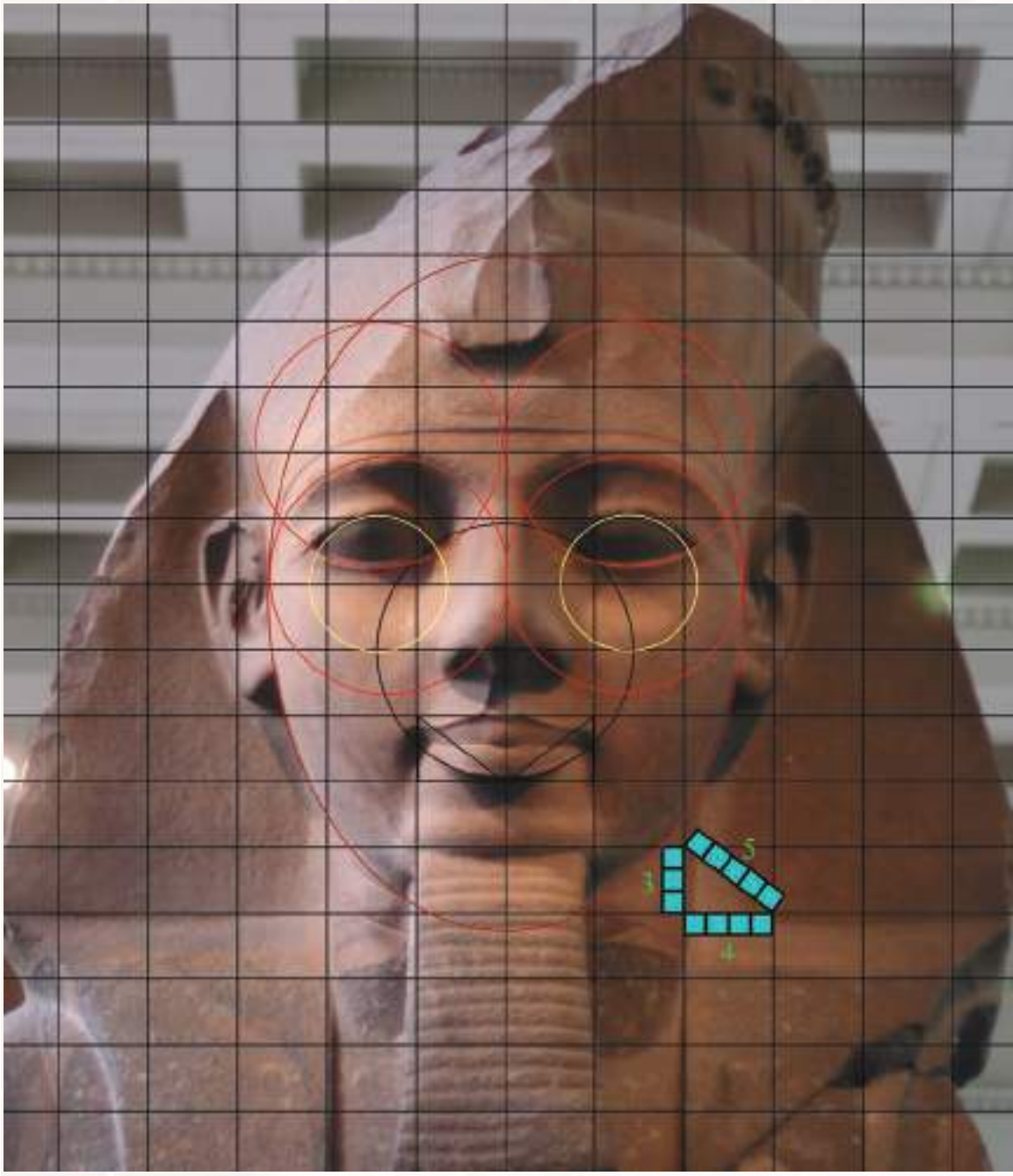
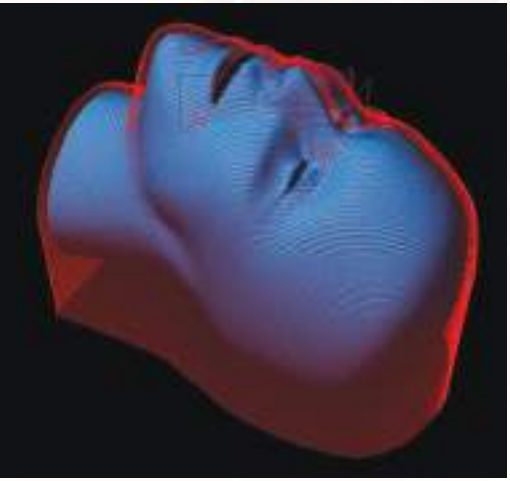


Plate 8. The Ramesseum Ramses inspires those in his presence to pay respect and understand what they behold.

Plate 9. The shadow cast along the face of Ramses at Karnak reveals the path of ancient tools.

Plate 10. Though unseen by the visitor, these ancient tool marks are revealed with the help of a telephoto lens and a computer's digital zoom.

Plate 11. The path a modern machine would take to craft a human head



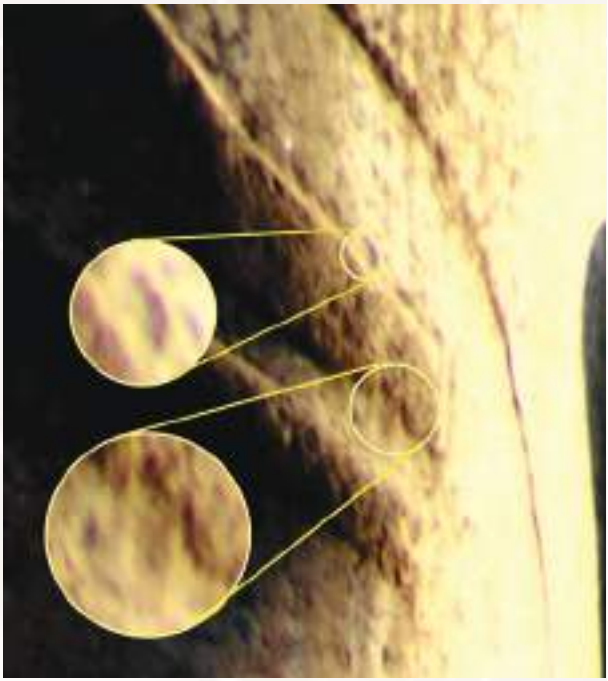
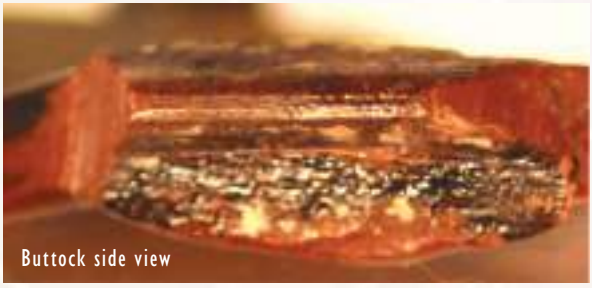


Plate 12 (left and below). Modern tools against ancient surfaces reveal a level of precision that should not exist.

Plate 13. Inspecting the corners of the inside of the box in Khafre's pyramid and finding unnecessary precision for the stated purpose of the box

Plate 14. While Ramses' face held a benign and almost joyous look, Nefertari holds visitors at bay with pursed lips and a haughty stare.



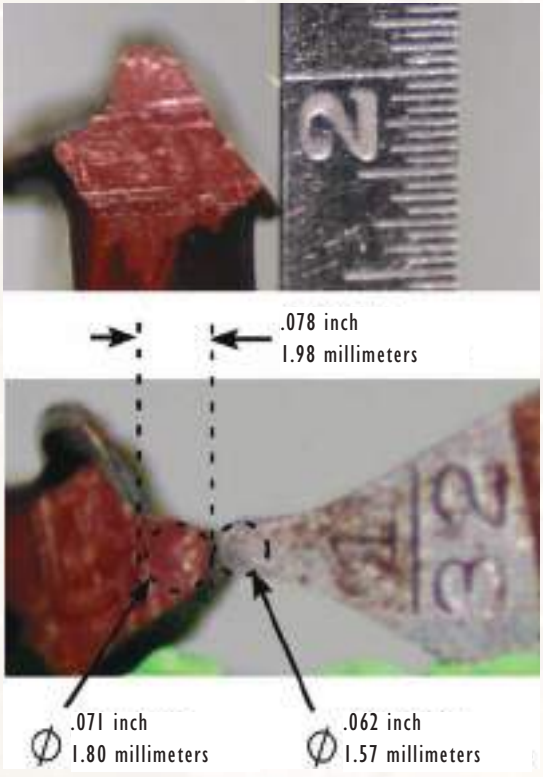
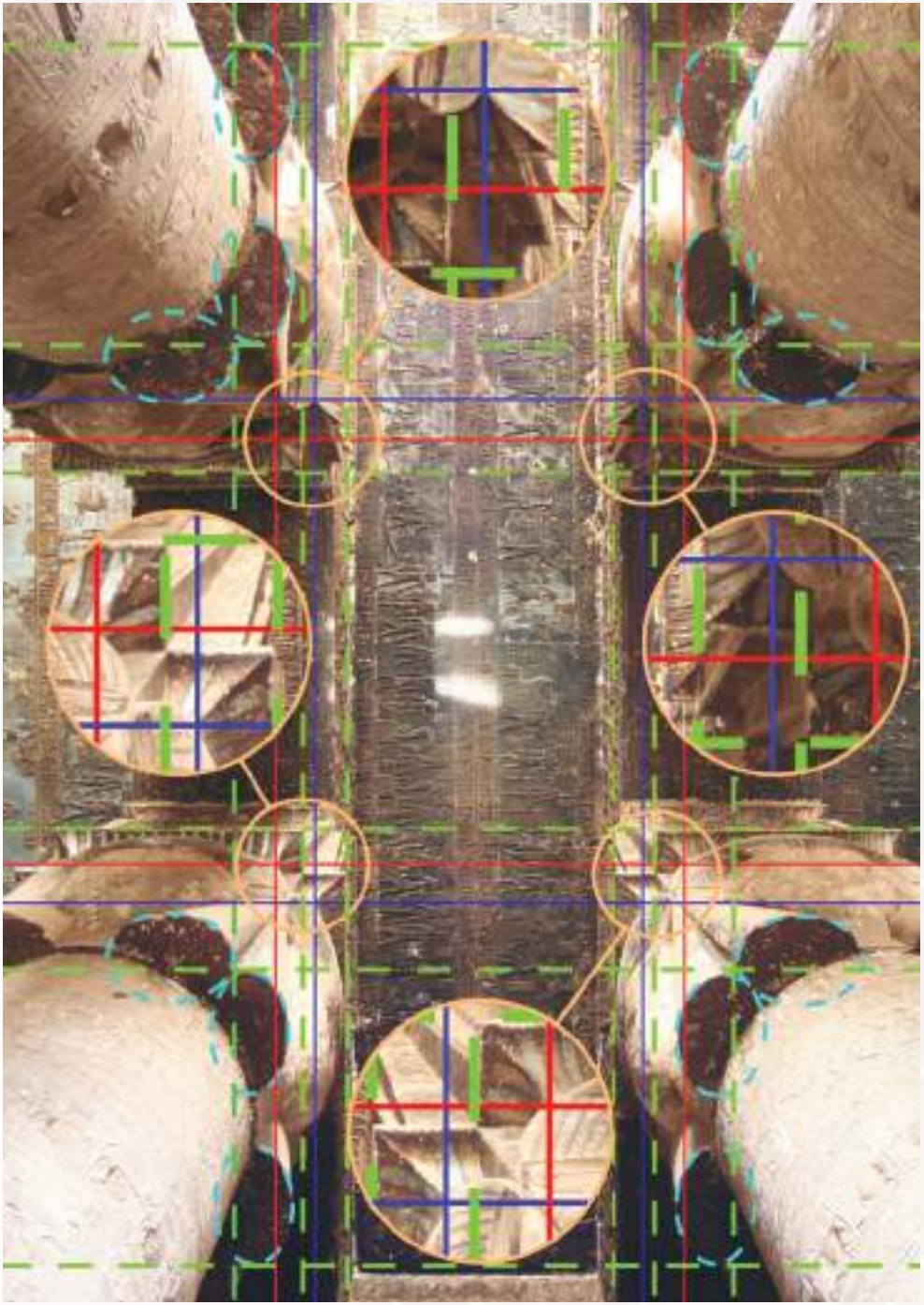


Plate 15. Wax impression taken of an undercut where Amun's buttock meets the bench on the Amun Mut statue in the Luxor Museum



Plates 16 and 17 (above and opposite). The columns in the hypostyle hall at Denderah represent a unified assembly of manufacturing, engineering, and architectural brilliance. Connecting individual capitals, solid red and blue lines cross where the cornice and cowl intersect. Green dashed lines define the straight-line geometric elements of the cornice. Ellipses define the bottom of Hathor's tresses.

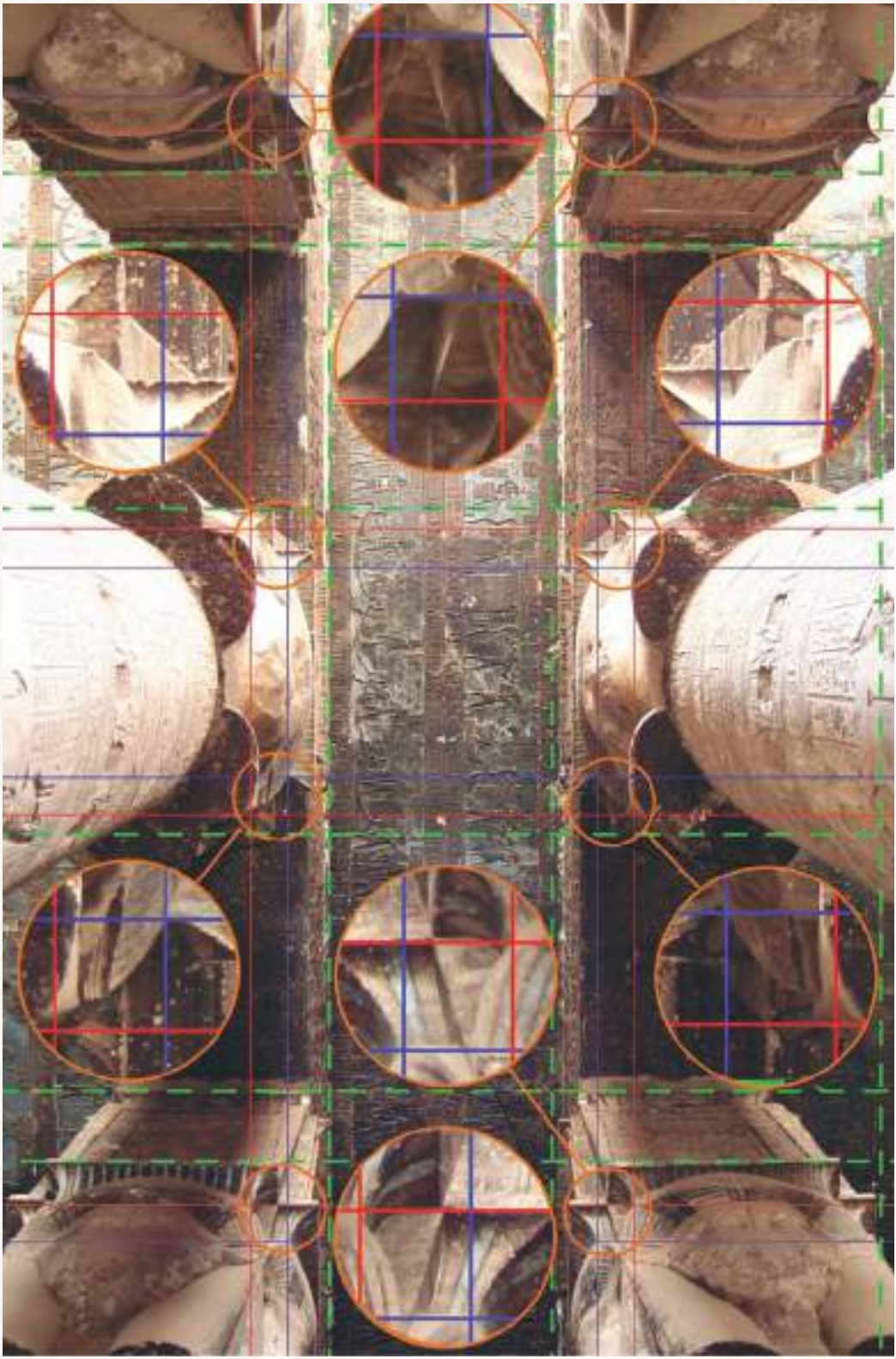


Plate 18. Views of one of several deep shafts in the Unfinished Obelisk trench

Plate 19. A view from the top of the pyramid at Abu Roash

Plate 20. The curved granite stone at Abu Roash

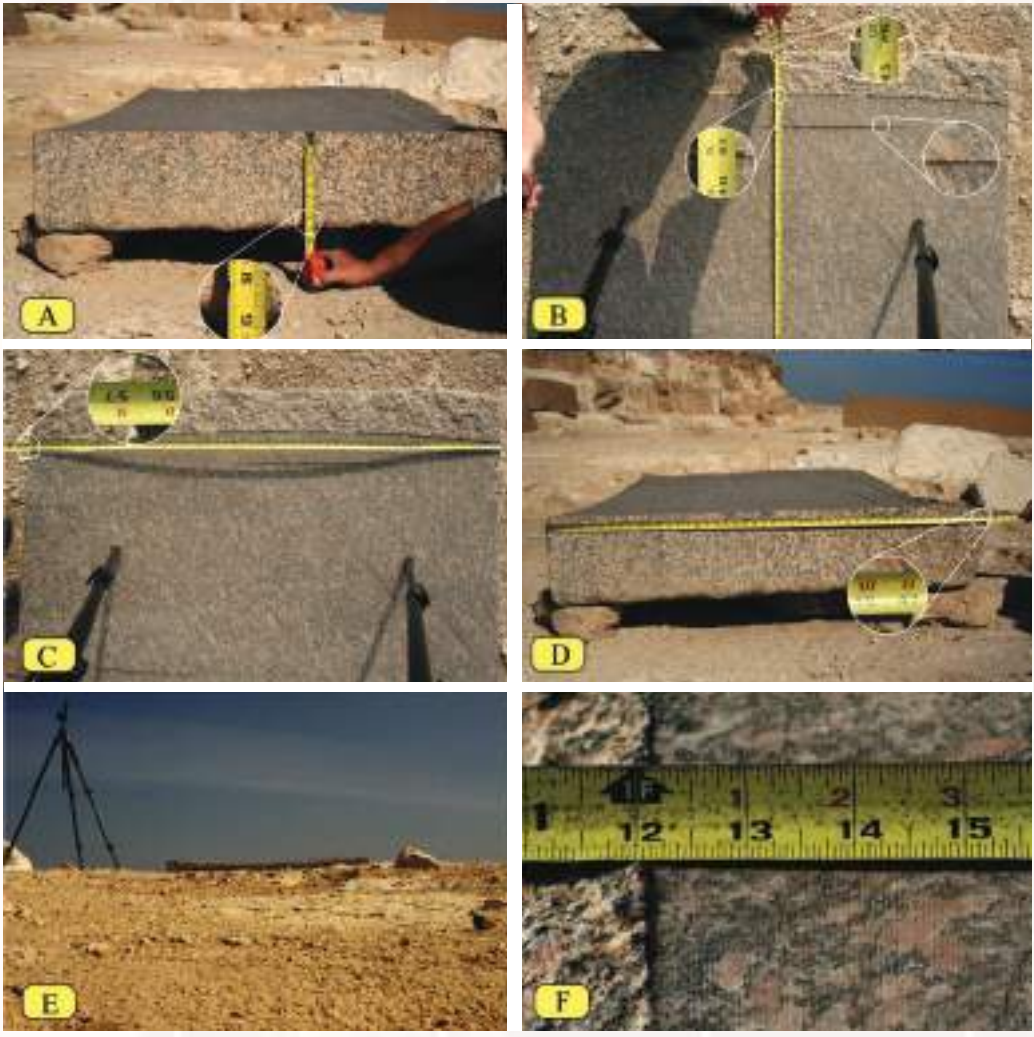


Plate 21. Measuring the stone at Abu Roash

Plate 22. Using a milling machine to replicate the curvature cut into the stone at Abu Roash

Plate 23. The Giza Saw Pits. These long trenches have been labeled “boat pits” by Egyptologists and are considered to be the symbolic transport of the dead king into the afterlife.

Plate 24. Did megamachines once cast their shadow on the Giza Plateau? There are some who believe they still do.

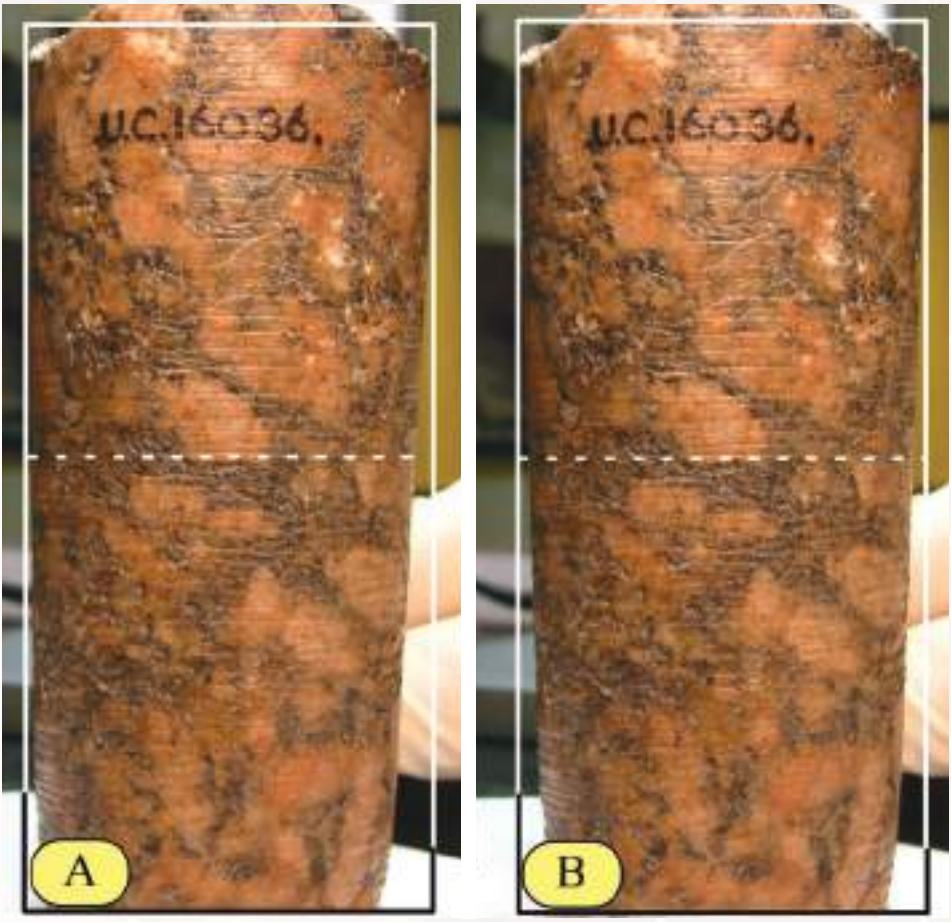
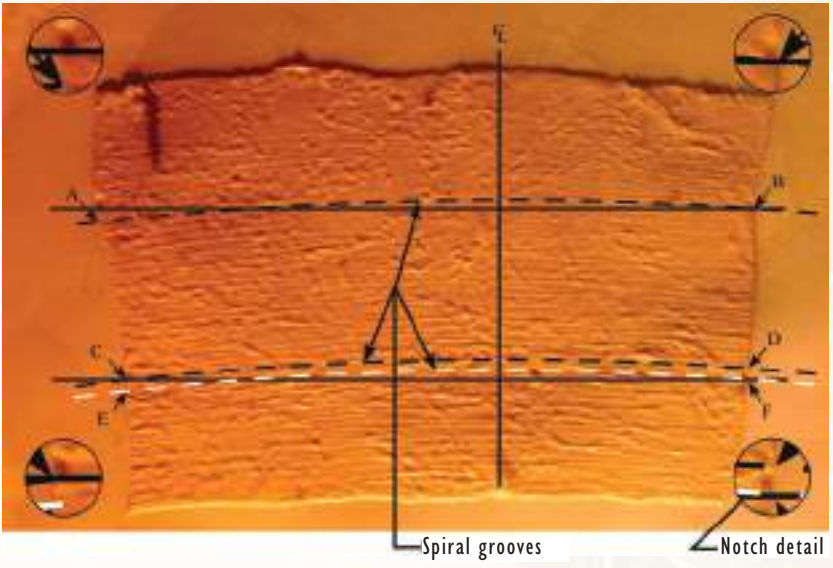


Plate 25. Petrie's Core 7. The left photograph shows it tilted on an angle, while the right photograph illustrates the core in a vertical orientation.

Plate 26. Geometry of a spiral groove on the unfolded latex impression of the Petrie's Core 7



What we find in Egypt, therefore, are examples of ancient ingenuity and technology that up to now have had no place in academic understandings of Egyptian history. Moreover, we have become so effective at convincing the world that the Egyptian civilization was not as technologically advanced as the Greeks or Romans, and certainly not the West, that many modern Egyptians themselves believe our story and are loath to accept any other.

It has been a common theme that the ancient Egyptians used simple, even primitive, tools and methods—so revisionist historians cast their eyes around the world to give credit to another culture. For instance, it has been speculated that these accomplishments were created by Atlanteans or aliens, because the prevailing view is that the ancient Egyptians could not possibly have done the work. I do not support such views. It is my firm belief that the work was performed by Egyptians—but Egyptians who possessed much superior knowledge and tools than we have heretofore credited to them. Consider the simple fact that these hidden symbols of technology became evident and understandable only through the use of modern technology and its standards of exactness and consistency.

Conception, execution, and verification are the phases of manufacturing. The ancient Egyptians must have used all three, with the last phase—verification—confirming the success of the first two. The only phase available for us to study is the last phase. From what we have learned from Ramses' crowns, we can determine that clearly the ancient Egyptians' level of technology must have been higher than what is revealed by the archaeological record. The question we are left with, though, is this: What technology did they possess? While the results of the ancient Egyptians' technology are now revealed by modern tools such as digital cameras and computer software, this does not mean that these tools were available to them. There is still a huge question mark regarding this facet of ancient history. In order to understand more about the technology used to create the crowns, we must take our studies further and look at how the rest of the statues were made. In the next chapter, complexity reaches a new level as we come face to face with the astounding results of an even more difficult challenge: Ramses' head.

2
The Shadows of Ramses

Uneasy lies the head that wears a crown.

Shakespeare, *Henry IV, Part 2,* Act 3, Scene 1

Our life is an apprenticeship to the truth that around every circle another can be drawn; that there is always another dawn risen on mid-noon, and under every deep a lower deep opens.

This fact, as far as it symbolizes the moral fact of the Unattainable, the flying Perfect, around which the hands of man can never meet, at once the inspirer and the condemner of every success, may conveniently serve us to connect many illustrations of human power in every department.

Ralph Waldo Emerson, *Essay on Circles*

The symbols left behind by the ancient Egyptian culture, a civilization that was brought down by a force of nature we tremble to imagine, have been the inspiration of countless scholars, artists, and ordinary laypeople. When it comes to studies of ancient Egyptian art and sculpture, the images we see evoke admiration and wonder and spark the imagination

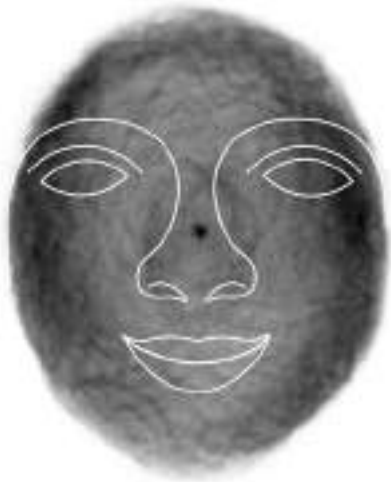


Figure 2.1. The Cosmic Egg

about what the Egyptian civilization found important. Resoundingly, what emerges is that the ancient Egyptians were deeply immersed in the mysteries of life and the survival of the soul after death. At the same time, they were not so submerged in spiritual matters that they eschewed materialistic comfort and pleasure. They acknowledged the hand of superior forces in the universe, and they spent a considerable portion of their wealth paying homage to the fickleness of gods as nature was interpreted by them and appeasing and preparing to be affected by nature's cycles on both a personal and community level.

From what we studied in chapter 1, we can gather that as a community, the Egyptians must have had an education system that taught citizens to understand geometry, and that they used geometry in a sophisticated way. The crowns in the Luxor and Karnak temples provide insight into a heretofore hidden school of design and manufacturing that started on the drawing board and resulted in finely crafted, very exact, and exquisite artifacts. Though they have been severely damaged by unknown forces, a sufficient amount of evidence remains that allows us to gather data with which to make an accurate analysis. Scattered on the ground from Alexandria to Cairo to Aswan, the evidence tooled into granite, diorite,

quartzite, and basalt—the hardest substances the ancient Egyptians could find in large amounts—may be all that is left to tell us how technically advanced these people were. To seriously consider replicating their accomplishments is a step toward understanding their advancement.

Continuing with the Ramses challenge, in this chapter we will study the head on the Ramses statue that sits outside the Temple of Luxor just a few feet from the obelisk. We don't know what forces separated the head from the body, but for our purposes, it seems quite fortuitous, in that it allows for a close inspection.

The ancient Egyptian engineers and craftsmen were more than capable of designing and manufacturing elegant, sophisticated, and precise shapes out of difficult-to-work granite, and they crafted impressive Hedjets and Pschents—the crowns of Egypt. It goes without saying—and, as we will see, the evidence shows—that the designers of the Ramses statue used the same talent to set about designing and crafting the pharaoh's head. As we can see by reviewing the process, this proved to be even more of a challenge than the crafting of the crowns.

During my visit in February 2006, I took photographs of the Ramses head after I photographed the crowns. At the time, I had not analyzed the crowns and was not expecting the symmetry and exactness that I saw in them. Similarly, from the perspective of a manufacturer, I pondered the symmetry of the Ramses head without really expecting the results that I ultimately gathered. It seemed highly improbable to me that a complex, three-dimensional surface profile could be replicated with exact precision from one side of the head to the other without employing some fairly sophisticated manufacturing techniques. I took my photographs not knowing what I would later uncover.

Ramses' exaggerated smile cannot be seen on the faces of normal people. I have looked for examples of such a smile and have not seen one on even the happiest face. Certainly, there are mouths that curl up at the corners, and a smile from such a mouth is a pleasure to behold. Ramses' face, however, is relaxed, and only the mouth appears to be smiling; there is no effect on the eyes and cheek muscles. We might wonder whether such a mouth was seen in ancient Egypt among the

citizenry or whether the designers were trying to please their gods by presenting an idealized image to them that they would find pleasing.

When I imported my original image of the head into the computer (see figure 2.3), I struck a horizontal line across the face and rotated the image until the line was barely touching the underside of the bottom eyelid. I then duplicated this image and flipped it horizontally so that the left cheek became the right cheek. I then made a 50 percent transparency of the image and lined it up with the jawline. As shown in figure 2.3, there is no variation between the left jaw and the right jaw.

Thinking about only this correspondence in the geometry of the face made me sit up and take notice. This symmetry means that the face was crafted so that a mirror image of the outline of the face was transposed to the opposite side. It is an incredible accomplishment that this exact line moved in three-dimensional space to create a perfect mirror image when viewed in two dimensions. My mind was racing at this point. What did the ancient Egyptians use to create such perfection? How did they inspect the geometry of the face? The same questions I asked when I studied the crowns flashed into my brain—though with more force and consternation. A human face is by far more complex and sophisticated than an ellipsoid that is blended with another form to form a crown (which we examined in chapter 1).

Of note, also, is the close alignment of the ears. Figure 2.2 shows clearly Ramses' left ear with some of its upper portion missing. In figure 2.3, this is evident, but at the same time, the ear cavity is very close to a perfect match. To be able to define the geometry of the ear is a challenge. To reproduce the geometry in three dimensions on opposite surfaces with 3 feet of granite in between these points—and to control their positions as precisely as these photos indicate—dispels forever the notion of ancient sculptors chipping away with stone hammers and stone or copper chisels.

Close your eyes and imagine a line that bisects your head vertically down the center, and then lightly touch the same point on your left and right ear with your index fingers. The touch of each finger feeds through pathways to the brain, the ears, and the fingers to create a sense of orientation. While undertaking this exercise, notice how your index

Figure 2.2. Ramses Head

fingers move slightly until you have a sense of equilibrium between the two. Yet how close is each fingertip to the imaginary axis bisecting your head? It's impossible to tell! Even though the left hand does know what the right hand is doing and both fingers provide sensory feedback to the brain—through the fingertips and ears—the brain cannot determine how precisely each ear was placed in relationship to the central axis of the head. Even the visual benefit of performing this exercise in front of a mirror will leave you lacking accurate data.

Figure 2.4 shows Ramses from two different angles and provides a view of each ear that is close to perpendicular to the face of the ear. I set up the camera to capture an image that was the same angle from the central axis. To accomplish this, I made adjustments so that the tip of the nose seemed barely to touch the far cheek from both angles. It should be noted that I could not achieve absolute precision under the circumstances because of the terrain and the lighting: I took the image on the right at a lower elevation than the one on the left, and this causes

Figure 2.3. Reverse transparency overlay matching the jawline

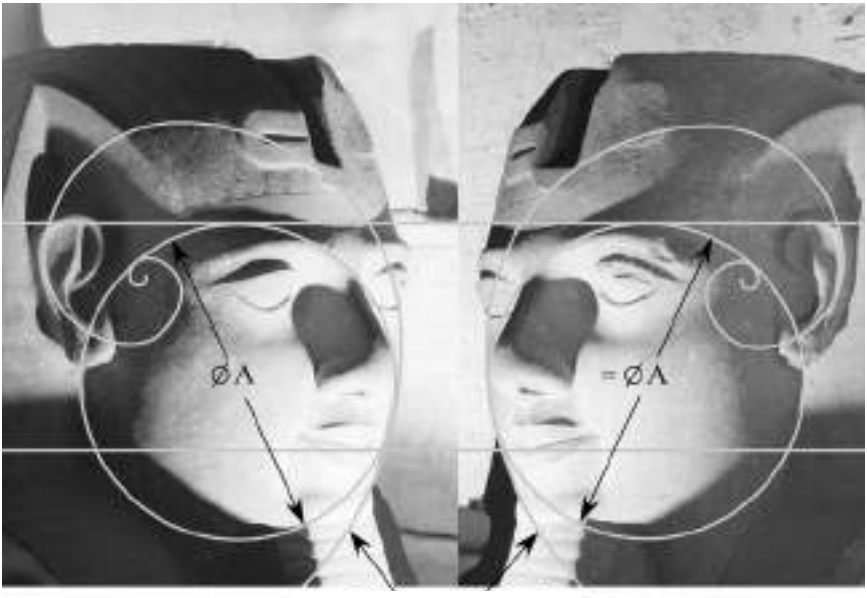


Figure 2.4. Left and right view of Ramses' head

a misalignment with the statue, because the camera angle is tilted up more for the right shot than when I shot the left side. Nonetheless, the results are quite intriguing.

The lines were applied to the photographs as references in order to size the two images of Ramses in the computer. I should stress here that the images were not distorted from their original aspect ratio during this process. I superimposed the Fibonacci spiral there to see if any correspondences occurred. Amazingly, there seems to be an uncanny and harmonious congruity between the spiral and the circle, as well as between the spiral and elements of both sides of the head. As I sized it to fit one side, then mirrored it for the other, the spiral was not changed in its size or aspect ratio.

Fibonacci, also known as Leonardo Pisano, published his discovery of the properties of the series 1, 1, 2, 3, 5, 8, 13, 21, 34, and so forth, in his book *Liber Abaci* in 1202,[1] but the mathematical construct was previously used in Indian mathematics by mathematician Virahanka (sixth century CE).[2] It has also been said, not without controversy, to have been used by the Egyptians in their architecture—to define, for instance, the geometry of height and slope of the Great Pyramid.

I should state here that my inclusion of Fibonacci spirals and circle geometry is not the result of a search for esoteric symbolism in the statue; it is simply a means to discern how the ancient Egyptians had created Ramses. I am not arguing that the ancient Egyptians intentionally encoded it into their statue. My investigation is intended more to illustrate the symmetry and exactness of the piece and explore the manufacturing implications than to argue for secret mystery schools, sacred science, and Leonardo da Vinci–style occult symbolism. Though I find these subjects fascinating, they are outside the scope of this book, and there are others who are far more knowledgeable than I on these subjects—so I will leave any such discussions to them.

The line that follows the shape of the ear in figure 2.6 is not a Fibonacci spiral but was generated from one ear, then copied and mirrored on the other. From the photographs, it is clear that there are slight differences between the two ears—but one ear is damaged and

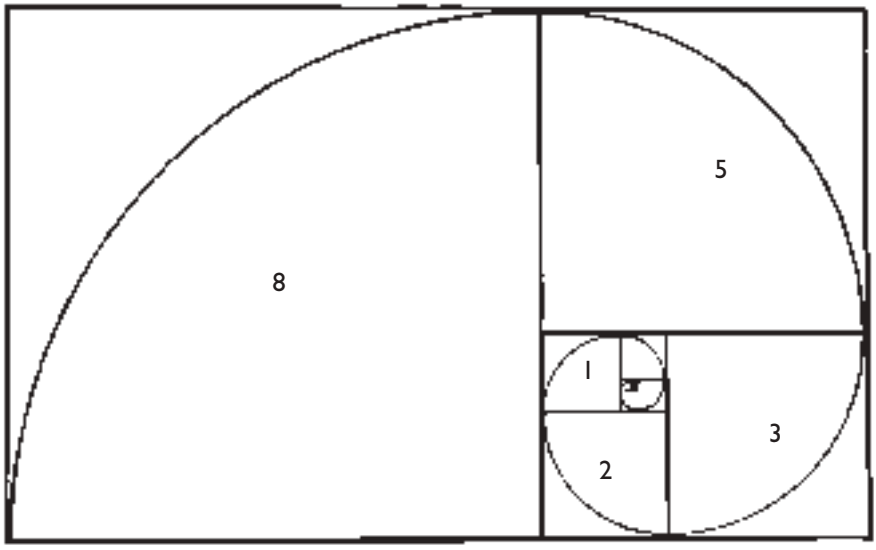


Figure 2.5. Fibonacci spiral

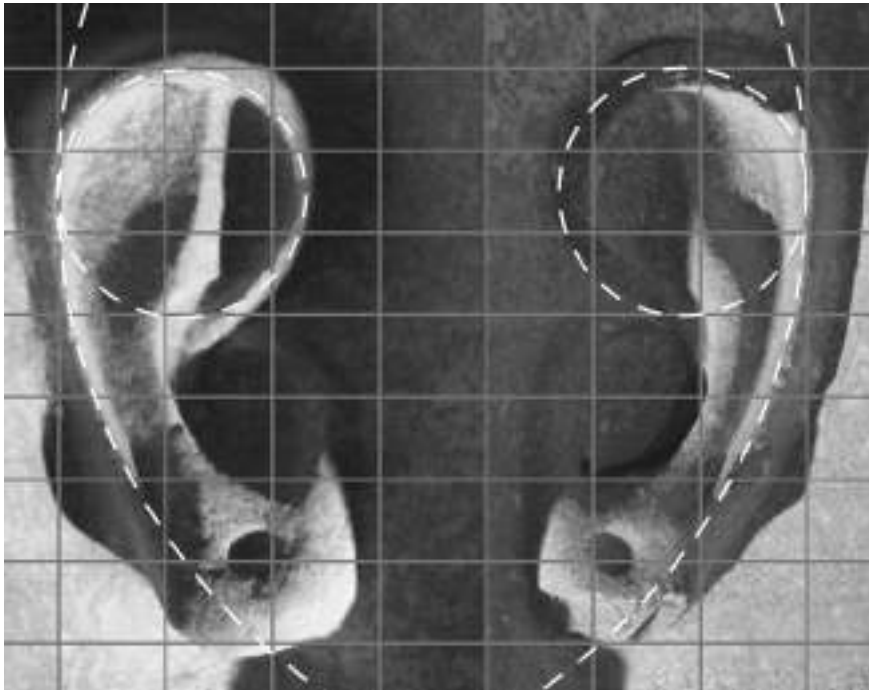


Figure 2.6. Ramses' ears

the lighting on both varies such that we cannot state with confidence that they are identical within precise tolerances. What we can state, however, is that figures 2.3, 2.4, and 2.6 illustrate a nearly impossible task for a sculptor. The probability of the finger on your left ear and the finger on your right ear being positioned within the tolerances shown in this series of photographs is virtually zero. The possibility of a sculptor creating a head with a jaw line that is identical on both sides and two ears that are within the tolerances as shown in these photos is also vanishingly small.

To accomplish what we see here, one has no other option but to focus on *precision*. We are confronted here not with a coincidence, a stroke of luck impressed with crude, handheld tools, but a stark reality that the order of precision found on Ramses' head demanded that the sculptor move into the realm of engineering and its essential science of measure: metrology.

If we study the face further, it becomes obvious that the reverse

Figure 2.7. Reverse transparency matching the eyes and mouth

Figure 2.8. Reverse transparency matching the nose

image is not a perfect match. The nose, mouth, and eyes—all principle features of the face—do not match with the jaw in alignment. Nonetheless, moving the transparency over these features slightly brings them together, though not all at the same time.

RAMSES' SHADOW

Given the off-center alignment of the photographs of Ramses' head, it became clear that I had to return to Egypt. When I examined the photographs I took of Ramses' head in February and began to compare the symmetry from one side of the face to the other, I realized that in the photographs I took when my camera was handheld (as opposed to on a tripod), the central axis of the camera frame was not quite in alignment with the central axis of the statue. I knew that I could not capture an image that was perfectly in alignment without trial

and error, and what I had produced had errors, so I determined that I could do better if I was able to use a tripod stand and take a series of photographs while moving the stand incrementally around the head and keeping the nose in the center of my viewfinder. To understand why this tripod setup is so important, we can consider the following series of sketches that represent a view from above looking down on the head.

The ideal camera setup is illustrated in figure 2.9. To achieve this, the camera axis is oriented exactly along the central axis of the head, which is a theoretical line that bisects the features of the head. If an image of the head is then taken, flipping the image on its horizontal axis would make for an identical image.

Figure 2.10 shows the head rotated 1 degree from center. What this means is that when the image is copied and flipped and compared to the original, some features will not match.

The arrangement we see in figure 2.11 is the same one that was captured by my camera with my first set of photographs of Ramses' head—when I copied, flipped, and overlaid a transparency onto the original. As we saw in figure 2.3, the mouth, nose, and eyes do not match, but the jaw outline matches perfectly. This is because the outline of the face is used to establish the central axis of the photograph and the nose is rotated slightly off-center.

As depicted in figure 2.7, by making the mouth the center point, the outline of the face is thrown off axis and the nose is thrown off axis. The eyes, because they are approximately at the same distance from the camera as the mouth, then come into alignment.

Even with a less than perfect alignment, however, I was elated by this discovery. The implications were immediately clear to me—and they were enormous. My preliminary studies indicated that the statue was crafted so that the left side was a mirror image of the right side. I realized then what was needed: I had to take another series of photographs and hope that one of them presented a closer alignment with the central axis of the head.

The photographs I took in May 2006 were certainly an improvement

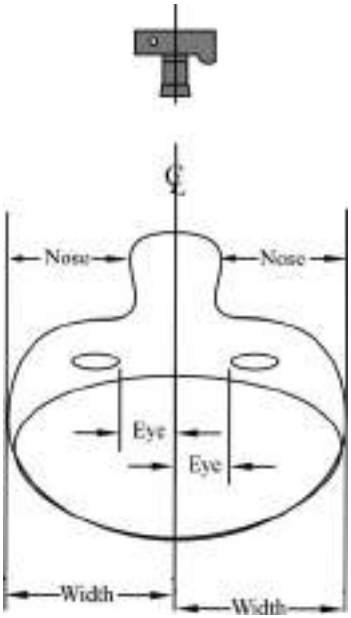


Figure 2.9. Top view of camera setup. The central axis is identified with an L overlapping a C, which is the standard notation engineers use in their drawings to denote a centerline.

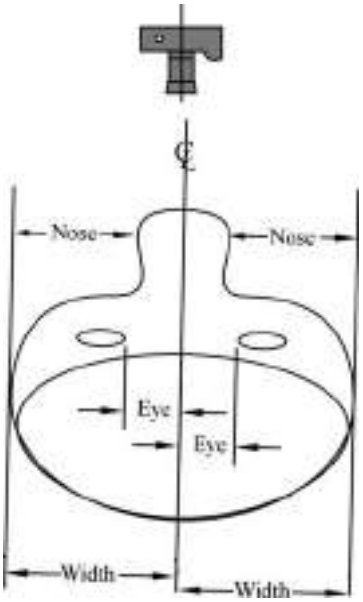


Figure 2.10. Rotated head

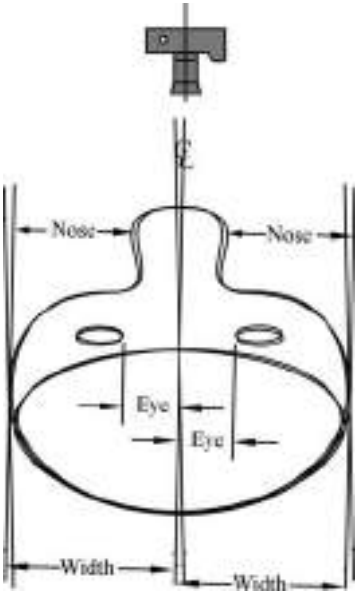


Figure 2.11. Double image

Figure 2.12. Ramses' symmetry, taken in incremental steps while moving the camera in an arc around the statue

upon those I took in February. However, I was still not quite satisfied with the results and returned in 2008 with a better camera that resulted in figure 2.12, which is photograph 70 of a series of 94 photographs that I took while moving the camera in action mode while panning in an arc around the statue, keeping the nose in the center of the viewfinder. I then duplicated the image and mirrored it and made a transparency, then positioned this over the original to match the features of the face.

As we can see, the match is much closer, but not perfect. Figure 2.12 shows that the jawline, mouth, and eyes match, but the nose is slightly off center. Figure 2.13 shows a close-up of the nose and mouth with the nose in alignment. It should be noted that the amount of error in the orientation of the camera is actually half of the width of the shad-

Figure 2.13. Ramses' nose symmetry

ows revealed when different features are brought into alignment. If the camera was adjusted by half the amount of the error shown, then all shadows may disappear.

As we can see from studying figure 2.13, the jawline, mouth, and eye from the right side appear to line up perfectly with the left, but it appears that the nose is slightly off center. In figure 2.14, the nose is brought into alignment and a shadow appears around the jaw and the lips. The shadow is quite useful for our study, because it actually provides a reference line with which to calculate the percentage of error from one side of the face to the other. These results are stunning—beyond anything I had imagined.

Though visually the comparison between the two sides of the face is remarkably similar, dimensionally it requires further examination with metrology equipment to measure exactly the differences between the two sides. From a manufacturing perspective, the dimensional variation from a perfect form (i.e., the tolerance band) on the contoured surface of a form die depends on the ultimate function or purpose of the piece. Today's machine tools can produce complex contoured surfaces to a level of accuracy that was not within the capability of machines forty

years ago. When we compare Ramses' head and modern machined surfaces, the analogy does not register as relevant or fitting, because the end products are created for completely different reasons, and a statue does not require the same precision as a contoured surface for, say, a rocker panel, a trunk lid, or a hood for a car body. Nevertheless, the comparison using a digital photograph compelled me to try to determine some kind of dimensional reference so that we can say with a reasonable amount of certainty that I was not influenced by an optical illusion.

To this end, and in order to draw from the photograph a relative dimension from one cheek to the other, I enlarged the photograph to approximately five times that of a human head and applied dimensions (measured in inches) from a vertical centerline to the outline of the jaw. In this way, there was no interference with an overlying transparency and the resulting shadow; thereby there was less uncertainty as to exactly where the edge of the face was.

The results in figure 2.14 show that the camera's axis was shifted to the left of the axis of the head, and the dimensions of the nose and the ears indicate that a mere 0.140-inch (3.55-millimeter) rotation of the camera to the right would bring these dimensions closer to being the same. On a human scale, the amount of error in the orientation of the camera would be 0.028 inch (0.711 millimeter), just slightly more than the thickness of a thumbnail. The dimensions of the jaw line are within a tolerance band of plus or minus 0.010 inch (0.254 millimeter), which on a human scale is plus or minus 0.002 inch (0.0508 millimeter). Close to the ears the tolerance band increases to plus or minus 0.065 inch (1.65 millimeters), which on a human scale is plus or minus 0.013 inch (0.33 millimeter).

Though they do not achieve perfection—but are much closer to the central axis of the head than those I had taken in February and May of 2006—the photographs featured in figures 2.12, 2.13, and 2.14 taken in November 2008 illustrate that slight variations in the camera angle can yield different results. Without specialized equipment and special permission, it is impossible to achieve the laboratory-type analysis that I am convinced must be achieved in order to quantify exactly the accuracy to which these statues were crafted. With the aid of two-

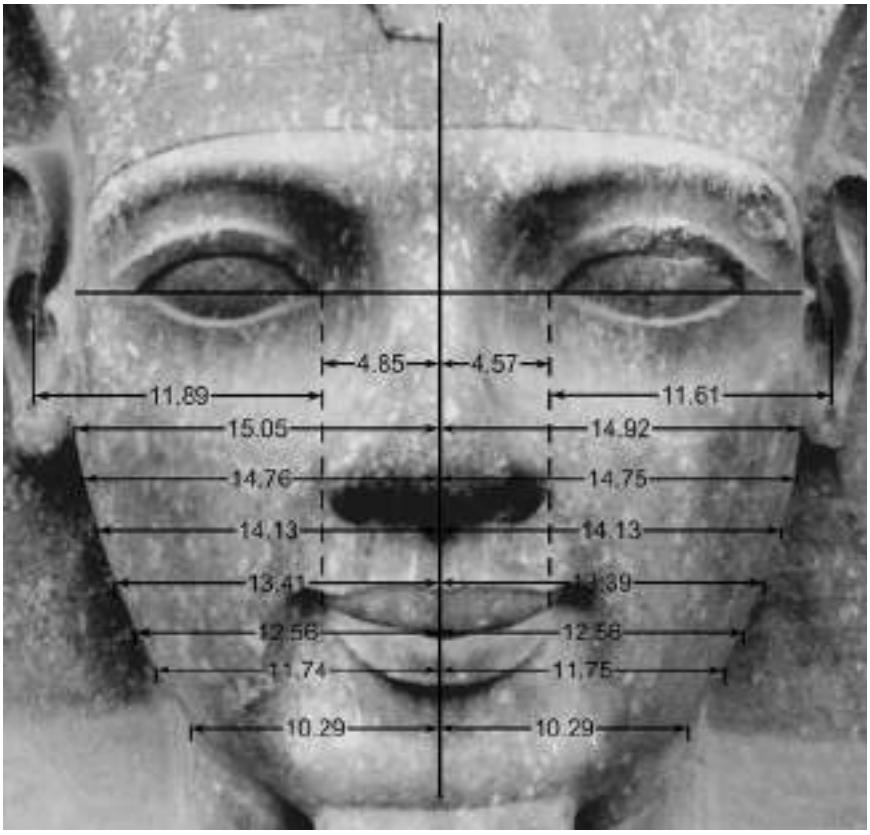


Figure 2.14. Ramses precision

dimensional computer software, though, we can extract some basic geometric information about the artifacts and compare one half of each face against the other. In this manner, we can glimpse, through the fog of millennia, the minds of the designers of the sculpture, and we can conclude that a sophisticated geometric protocol was used. Designers, engineers, and craftspeople in the modern era may relate to the complex sculpted surfaces that have been proven here to create both sides of the face in mirror image.

The contoured surfaces of Ramses' symmetrical face would be familiar to designers of everyday products that are created routinely today with computer algorithms known as non-uniform rational B splines (NURBS), which allow them to smoothly morph one shape to

another with unbroken perfection. By using NURBS, computer-aided design programs create contours of airplane wings, turbine blades, and even the computer keyboard at your fingertips. Surfaces are now routinely designed and manufactured to the apparent precision of Ramses' head. Incredibly, the ancient Egyptians were also able to routinely craft Ramses' head and achieved the same results again and again from the north to the south of their linear, Nile-based empire.

The stunning implications are analogous to looking through the static interference pattern of time and confusion and seeing the elegance and precision that is normally built into a Lexus in a place where only the most rudimentary techniques of manufacturing are thought to have existed. The techniques that the ancient Egyptians are supposed to have used—those taught us in school—would not produce the precision of a Model T Ford, let alone a Lexus or a Porsche.

BACK TO THE DRAWING BOARD

There should be no question in our minds now that Ramses' face was carefully designed using a system of measure that was based on geometric proportions. But what geometric shapes did the ancient Egyptians use, and how were they applied in the design?

We know that the ancient Egyptians used a grid in their designs,[3] and that such a method or technique for design is intuitively self-evident. It does not require a quantum leap of an artisan's imagination to arrive at what is today a common design method. In fact, it is used now not just for design, but also for describing organizational and conceptual methodology. Grids, graphs, and charts are used to convey information and to plot and organize work.

With this in mind, therefore, I took the photograph of Ramses and laid a grid over it. Of course, my first task was to establish the size and number of the cells used in the grid. I assumed that the features of the face would lead me to the answer, and studied which features were most prominent. After musing over this question for a while, I took a chance on a grid that was based on the dimensions of the mouth. It seemed to

me that the mouth had something to tell us due to its unnatural shape, so I placed a grid with cell dimensions that were the same height and half the width of the dimensions of the mouth. It was then a simple matter to generate circles based on the geometry of the facial features. I didn't expect, though, that they would line up with grid lines in so many locations. In fact, I was astounded by this discovery. Going through my mind was: "Okay—now when does this cease to be a coincidence and become a reflection of truth?"

PYTHAGORAS MEETS RAMSES

Plumbing the grid for further information, I discovered that Ramses' mouth had the same proportions as a classic 3-4-5 right triangle. The idea that the ancient Egyptians had known about the Pythagorean triangle before Pythagoras, and they may have even taught Pythagoras its concepts, has been discussed by scholars, though not without controversy.[4] Ramses presented me with a grid based on the Pythagorean triangle, whether it was the ancient Egyptians' intentions or not. As we can see in plate 4, the Pythagorean grid allows us to analyze the face as it has never been analyzed before.

In a manner similar to that of the geometry of the crowns, as discussed in chapter 1, plate 4 shows that circle geometry was also used in the design of the face. The correspondences that appear between the grid and the circles that are generated by the facial features are numerous and noteworthy. This design scheme is fairly simple and elegantly harmonious, because all elements are interrelated and have connections to each other, whether crossing or touching their companion elements. For example, Circle A, the bottom eyelid, and Circle C, which describes the top of the upper eyelid, touch Circle F, which outlines the jaw. At the same time, Circle A is tangent to the grid and crosses the grid and Circle B at the same point. All the circles are tangent to the grid except circle C, which is tangent to the jawline. Circle G, which describes the arc of the lower lip, is tangent to the grid and Circle C. These elegant correspondences were created with full knowledge that

minor changes in the circle diameters would provide different information, so it could be argued that a different geometric scheme could have been intended. However, the point in presenting it this way is to illustrate the geometric constructs that an artist might use if they were going to paint a portrait of a perfectly symmetrical head. What elevates the importance of this design is the fact that it was three dimensionally crafted, with elegance and precision, in hard granite.

FIBONACCI MEETS RAMSES

We may ask if there might be another way to describe the geometry of Ramses' face. I pondered this question for a long time, and while examining the shape of the ear, I thought perhaps a Fibonacci spiral might have been employed in the design.

A Fibonacci spiral is created by blending a series of arcs that are generated using three corners of each of the squares depicted in figure 2.5 (see p. 47)—with one corner as the center point of each radius. As it turns out, the Fibonacci spiral did not match the geometry of the ear. Yet because I had already drawn the spiral in the computer and had the image of Ramses up on my computer screen, I tried to see if there were any correlations using a Fibonacci spiral with the geometry of the face and the Pythagorean grid. Once I established the grid pattern and the circles, I trimmed back the circles and drafted the outline of the nose to create figure 2.15.

Using the outline of the Ramses face with just the Pythagorean angle grid, I applied a series of well-known geometric constructs to determine whether any correlation existed between Ramses' head and more advanced geometry than what I had seen so far. Quite remarkably, the oval that frames Ramses face is based on the Pythagorean 3-4-5 triangle (its height is 1.333 times greater than its width).

As we discovered earlier, the Fibonacci spiral is based on the number series 1, 1, 2, 3, 5, 8, 13, 21, and so forth (see figure 2.5 on p. 47). Figure 2.16 illustrates how the spiral corresponds to the drawing of the Ramses' face and the grid.

Figure 2.15. Ramses' outline drawing

Figure 2.16. Ramses, Pythagoras, and Fibonacci

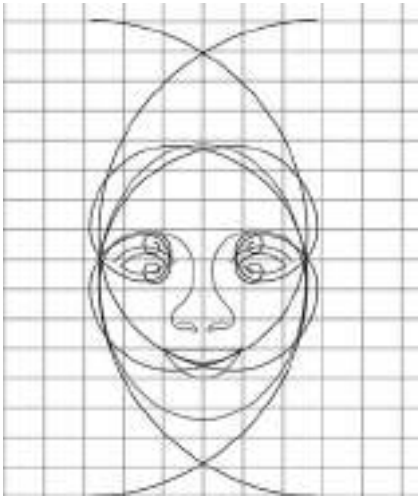


Figure 2.17. Ramses with four Fibonacci spirals

Figure 2.16 illustrates the construction of the Fibonacci spiral using the Fibonacci series 1, 1, 2, 3, 5, and 8. As we can see, the spiral has been sized to touch the right jaw and to circle the eye. We can note other correspondences to the bottom line of the grid and the top of the oval that was created from the outline of Ramses' jawline.

Figure 2.17 was created using copies of the spiral that are mirrored horizontally and vertically. The vertically flipped pair was aligned with Ramses' mouth. We can see correspondences where the spirals cross and where they end on grid lines at the top and the bottom.

LEONARDO MEETS RAMSES

The Golden Ratio, or Greek Phi ϕ, expressed as the mathematical constant 1.6180339887, has been used in art and architecture, including in such Renaissance masterpieces as Leonardo da Vinci's painting of the Last Supper and in the Notre Dame Cathedral in Paris. Its proportions are said to be embodied in the human form and can also be found in nature, but certainly it is used deliberately by those who strive to achieve aestheticism in their work. The proportions of the Golden Ratio, also known as the Golden Section, are expressed using both triangular and rectangular shapes.

Figure 2.20 illustrates four Golden Rectangles of equal proportion. The rectangles that frame the width of the nose look narrower than the

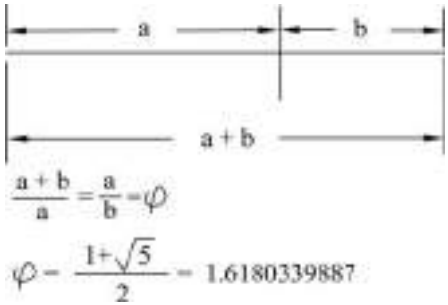


Figure 2.18. The Golden Ratio

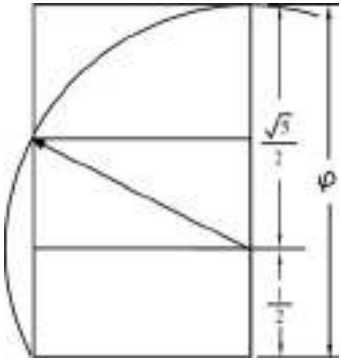


Figure 2.19. The Golden Rectangle

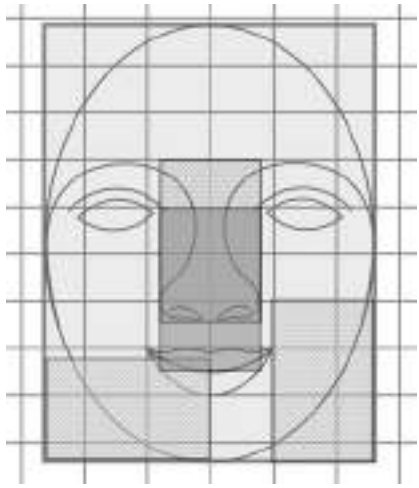


Figure 2.20. Ramses' Golden Rectangles

other two, but this is an optical illusion caused by two overlapping and offset rectangles. The rectangle was generated using the width of the nose as the base square multiplied by 1.618033, the Golden Ratio, to achieve the height ratio. The rectangle was then positioned under the nose, where we see it lined up with the eyebrow grid line.

Three copies of this Golden Rectangle were then made, and two were then fitted to the bottom corners of the Golden Rectangle that frames the oval shape of Ramses' face, with one Golden Rectangle on the left bottom corner rotated 90 degrees. The third Golden Rectangle was then shaded differently and placed with the bottom surface aligned with the Ramses' mouth. As figure 2.20 illustrates, the top of this Golden Rectangle corresponds with the grid line that is tangent to Ramses' eyebrows.

It would seem reasonable at this juncture to suggest that the key to Ramses' geometry has been discovered. The face, grid, and Golden Rectangle working in unison strongly imply that all three were used in the placement of the different features of the face. This geometry and the circles seem to give us enough information to explain the two-dimensional drawing of Ramses. However, while this is a compelling argument, the testimony of the famous architect I. M. Pei may cast

doubt on the intentional application of the Golden Section by the ancient Egyptians. His design of the pyramid at the Louvre in Paris is considered to be a masterpiece and incorporates the Golden Section in its design. During an interview with Ekwanim Productions of Paris he was asked if he was inspired by the same proportions that are found in the Great Pyramid. Pei claimed that he came by the Golden Section naturally and that he has abandoned strict adherence to measurement, preferring to arrive at his designs through his intuitive and artistic eye for what is pleasing, and the Golden Section appeals to a more right-brain approach to shaping the architectural landscape. The question should be asked, therefore, whether the ancient Egyptians were similarly influenced. Regardless of what their answer might be, however, engineers working under the direction of Pei, as well as those involved with the designers of Ramses, had to apply measurement to convey to the craftspeople the information they needed in order to bring what may have been inspired creativity into physical manifestation.

Unfortunately, the question of Ramses' head is much more complicated, because it involves three-dimensional geometry, not just lines and circles on a flat piece of paper.

RAMSES BOUQUET

While working in my CAD program, my wife suggested that I see how the Flower of Life fit with the geometric scheme that was crafted into Ramses' face. I didn't think much of the idea (probably a typical left-brain engineer response), but nevertheless, I set about drafting a Flower of Life in my computer. The results are fascinating to look at, but far be it from me to suggest that the designers were dropping flowers all over their plans! Yet this superimposition illustrates, in an analogous way, the complexity of the three-dimensional geometry of Ramses.

The Flower of Life symbol is considered to be sacred among many cultures around the world and is seen as symbolic of the connectedness of all life and spirit in the universe. It is found inscribed in some temples in Egypt—most notably at Abydos, where it is drawn, with meticu-

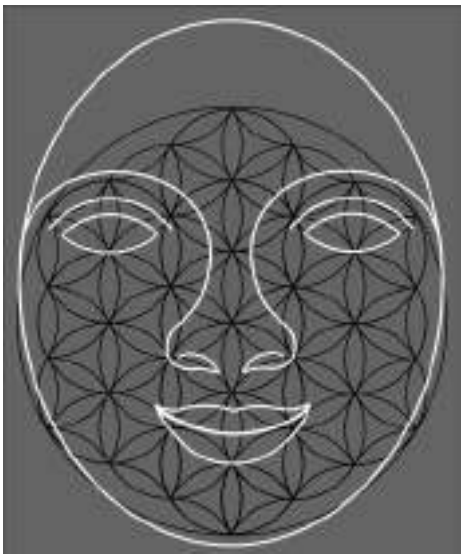


Figure 2.21. Ramses bouquet: the Flower of Life

lousness, in red ochre on a giant granite support column in the Osirian. The temple contains several of these drawings, and they are believed to have been placed there when the Osirian was filled with sand, for they are located high on the column.

The geometry of the flower consists of intersecting circles that create six equally spaced petals. The arrangement of the flowers in a mandala is supposed to symbolize unity with the cosmos and aspiration for harmony and perfection. It is a powerful icon in the Indian culture, and it commands profound philosophical and religious reverence.

Though I am not arguing that the use of these geometric elements were necessary to create Ramses' head, the correlations with the statue of Ramses do illustrate the reality of a greater sophistication than what two-dimensional images can convey.

FROZEN MUSIC

The mathematical principles of musical harmony are directly related to geometry. Pythagoras brought these concepts to the Western world

and inspired the orderly and disciplined understanding of objects we observe and create. Leonardo da Vinci used geometric archetypes, sometimes called *sacred geometry,* in his art. The German writer Goethe and the English expatriate Oscar Wilde, as well as the philosopher A. W. Schlegel, considered architecture to be "frozen music."

Grand musical events are planned with the accompaniment of the imposing grandeur of frozen music. To celebrate the inauguration of Cairo's Theatre de l'Opera in 1869, Ismail Pasha, Khedive of Egypt, commissioned Guiseppe Verdi to write an opera. Inspired by ancient Egyptian architecture and with the help of Auguste Mariette, he produced *Aida,* which has played for large audiences at Luxor and more recently on a large, specially built stage at the foot of the Giza Plateau. Egyptologist Zahi Hawass pleaded for the set to be removed, because it detracted from the archaeological value of the area.[5]

Though we don't normally consider objects around us to be musical, as a carefully designed and crafted geometric shape, a musical instrument that sits quietly in the corner of the living room could be considered frozen music. In this respect, the analogy between architecture and music can be considered correct—but it may also pose the question of whether there is such a thing as frozen music at all. It could be argued that when an observer is introduced to and interacts with a geometric structure, whether it is an instrument to play or a building within which to pray, it has an effect on the senses. Without the presence of people, the building responds to subtle energies from the earth and the environment through seismic or thermal movement of its structural components. An instrument adds its own voice, responding in resonance to weak forces, but the output cannot be discerned by the human ear. The grand piano sitting in the corner of my living room plays a faint encore after all sources of sound are turned off and nothing but quiet reigns.

Scottish composer Stuart Mitchel discerns frozen music in the design of the Rosslyn Chapel in Scotland. His analysis of the architecture of this structure reveals archetypal designs that are associated with certain frequencies that affect membranes that have been dusted with

fine sand or powder. The powder organizes itself into patterns on the membrane according to the acoustic wave pattern generated by the frequency on the surface of the membrane. Stuart's music can be sampled at www.tjmitchel.com.

The geometric proportions of the Temple of Amun Mut Khonsu (commonly known as the Temple of Luxor, though it is not the only temple in Luxor) were measured by Schwaller de Lubicz and were found to have been designed with harmonic proportions encoded in the dimensions of their architecture. To experience the temples of Egypt is to become absorbed in harmonic proportion, and they have influenced many travelers.

In *The Beginner's Guide to Constructing the Universe,* Michael Schneider writes, "Earthly Music was seen as a mirror image of the heavenly ideal descending from above."[6] After working with a Ramses' head and discovering the correlation between its features and well-known geometric shapes, I decided to draw the example that Schneider gives

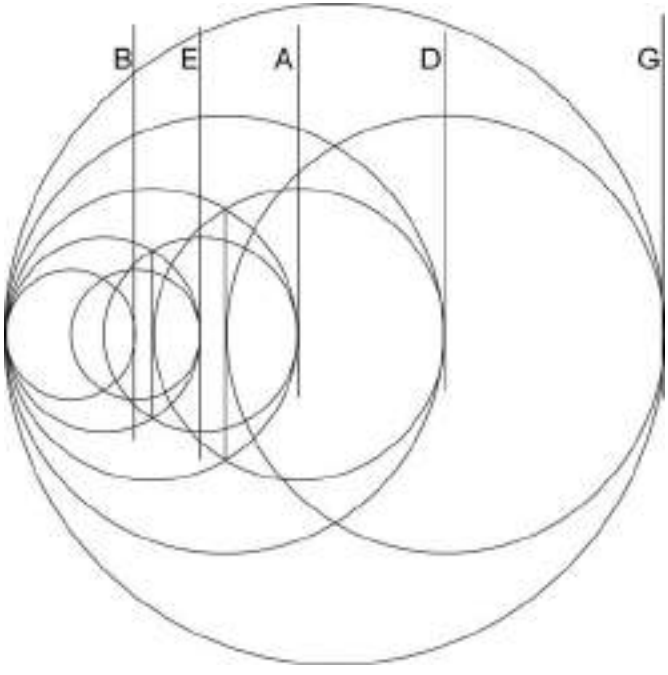


Figure 2.22. Harmonic scale of Apollo Zeus harp

in his lavishly illustrated book of the harmonic sequence of an Apollo Zeus harp. One of the sequences given includes the notes B flat, E flat, A flat, D flat, and G flat (the five black notes on a piano). The notes were played on the harp covering three octaves, from high notes to low notes, and are described as overlapping circles with nodes that represent the length of a string.

I then overlaid the image of Ramses with the Flower of Life with the geometry of the head, rotating it 90 degrees and scaling it so that the small circles were the same size as the flowers. The top circle was then placed over the uppermost flower. The correspondences that flowed from this arrangement are shown in plate 6.

RAMSES' HARP CORRELATION TABLE

Musical Note	Flower of Life	Face and Grid
B	Center of three flowers	Bottom eyelid
E	Center of three flowers	Tip of nose
A	Center of two flowers	Parting of lips and lower lip profile/Vertical lines on grid
D	Perimeter of flower	Vertical and horizontal lines on grid
G	Center of two flowers	Horizontal line on grid

With the Flower of Life, the face takes on a more three-dimensional appearance, which is necessary in order for us to appreciate fully what was accomplished. The geometry is more complicated, but not as complicated as what is necessary to create two identical, mirrored, three-dimensional surfaces in granite. The intricate web of correspondences among the face, the harmonic sequence, the flower, and the grid seems to establish a physical manifestation and integrated expression of art, mathematics, music, and engineering.

In chapter 1, we saw the perfection of the Hedjet and the Pschent. They presented us with a hint of techniques in ancient Egypt that have

been unknown until now—techniques whose application required workers with both the knowledge of absolute accuracy in manufacturing and the tools to accomplish it. We are leaving Ramses' face with a greater understanding of the difficulty involved in manufacturing the head. Though we have worked thus far with only a two-dimensional view, our results have yielded enormous implications. In the next chapter, we will examine the third dimension of Ramses' head: a 90-degree view of its profile from both left and right. We will then examine other Ramses figures to compare their geometry to the one we have been studying and examine some ideas as to how these mammoth objects could be created today.

3
The Ramses Challenge

An answer brings no illumination unless the question has matured to a point where it gives rise to this answer which thus becomes its fruit. Therefore learn how to put a question.[1]

Isha Schwaller de Lubicz,
Her-Bak: The Living Face of Ancient Egypt

Figure 3.1. Nefertari, Ramses' guiding hand

RAMSES' SMILE

As I pondered the features of Ramses' face, I found it quite curious that his mouth was turned up in an exaggerated smile (see figure 3.2). Though some might argue that having a wife with the attributes of Nefertari would give any man cause to smile, visitors to the temple are faced with what seems to be a synthetic smile that gives the face of Ramses a rapturous countenance. Examining the mouth closely, there appears to be anomalous geometry that does not blend with the contoured surface of the face. In fact, it appears that the face was cut first and then a separate tool shaped the mouth—and that this tool followed a contour that left a sharp cusp along the upper *vermilion border* (the junction between the mouth and the facial skin) of the mouth. It is particularly pronounced at the *philtrum* (the trapezoid-shaped indentation that joins the nose with the mouth) and forms a sharp, triangular point.

Figure 3.2. Ramses' smile at Luxor

The triangular point where the philtrum meets the vermilion border on the Ramesseum Ramses is even more pronounced. The smile, though, does not appear as exaggerated as on the Ramses at Luxor.

Why is the curve of the Luxor Ramses' smile so exaggerated? Further, as we've seen, only the mouth is smiling; the rest of the face is at rest. Even if the muscles of the cheeks were pulled up, as they would be if anyone tried to smile this big, it is doubtful such curved lips could be achieved.

I puzzled over Ramses' unnatural smile, but it seemed to me that it wasn't shaped this way merely to achieve a Pythagorean triangle; perhaps there was another reason for its appearance. Creating a line drawing from the features of the face and then removing the photograph revealed an image that was uncomplicated and distinct (see figure 3.3). Then it dawned on me that I was studying a face that was not in situ, but close to eye level—originally, the head was connected to a statue that was approximately 40 feet tall.

The seated Ramses figures at Luxor tower above the tourists at the temple. The proportion of both the people and their interaction with the statues has some bearing on the design of the statue, as we can dis-

Figure 3.3. Ramses' iconic features.

cern from the face. Ramses' smile appears exaggerated only when we view the head at the same elevation. When viewed from the ground, the smile from the shortest to the tallest statue, 40 to 60 feet (13 to 18 meters) high, appears more natural. We can see one illustration of this effect when we look at our own mouth in the mirror, then notice that when we raise our head, our mouth appears downturned. To understand this effect even further, we can hold an egg vertically by the ends and draw a straight line horizontally from one side to the other. When we rotate the egg either toward or away from ourselves, the straight line appears curved. Obviously, when the ancient Egyptians visited the temple, they preferred to meet with a beneficent-looking king, rather than one who had a frown frozen on his face. Thus, the seemingly unnatural smile of Ramses when we view it straight on was calculated to appear natural via the perspective of someone at ground level. This is why the Ramesseum Ramses' smile looks natural: the photograph was taken looking up at the statue.

We can note another example of geometric warping for visual effect in the fluted Doric columns of the Parthenon. The Greeks developed a technique known as *entasis* to avoid an optical illusion caused by the shaft's fluting (parallel vertical lines): In a tall structure such as the Parthenon, these lines appear concave. To compensate, the Greek architects made the columns slightly convex, so that to the viewer they seemed straight.

Modern architects and engineers are still trying to understand how the ancient Greeks were able to build the Parthenon in ten years when the restoration of the monument has continued for more than three decades and is still not complete. What they have learned and shared along this arduous path of rediscovery is that the Greeks were highly skilled at building visual compensations into their structures. Columns were crafted and positioned to compensate for how the eye interprets what it sees at a distance. Subtle variances in the surfaces of platforms, columns, and colonnades provide the appearance of geometric proportion, whereas if they had worked from the perspective of a flat datum surface, the brain would interpret the results as being slightly skewed.[2]

In the face of Ramses, we see that such compensatory concepts did not originate with the Greeks, but instead were used by the Egyptians at Memphis and Thebes more than a thousand years earlier. If a normal mouth had been crafted onto Ramses' face, it would appear from the ground to be turned down in a frowning shape. To confirm this, we can look at the image of the statue of Ramses at Memphis, near Saqarra.

The statue of Ramses at Memphis is estimated to have originally weighed more than 300 tons. Though it once stood upright, the statue now lies on its back in the open-air museum at Memphis. It is crafted of fine limestone and, as the photograph taken from the viewing mezzanine illustrates (see plate 7), is manufactured using the same inexplicable precision and product value as the Ramses statues at Luxor. The symmetry is maintained between both halves of the face, and the exact surface of both sides of the face of the statue is composed of curves of varying dimensions that flow together. The Memphis Ramses provides us with information that we are able to infer by viewing the front and side views of the Luxor Ramses, because the photographs of the front and side of Ramses' head at Luxor provide two-dimensional views of three-dimensional geometry. The Memphis Ramses, on the other hand, provides us with information that clearly shows that the features on both sides of the face are mirrored in not just two dimensions (x and y), but three (x, y, and z).

The appearance of true arcs on the contour of the eyelid of the Memphis Ramses suggests that the eyeball itself is an accurate sphere around which a radius is drawn in one axis to create the eyelid and, as a naturally occurring function of geometry, when viewed at other angles, always appears as a radius, though with different dimensions. In fact, similar to the crowns that we studied in chapter 1, the entire face has the appearance of being made up of nothing but blended spheres or ellipsoids that predict that, regardless of the angle from which they are viewed, they would present to the eye natural blended radial surfaces.

The down-to-earth reason for the unnatural smile, therefore, is that when viewed from the ground, it appeared to be natural. The photo-

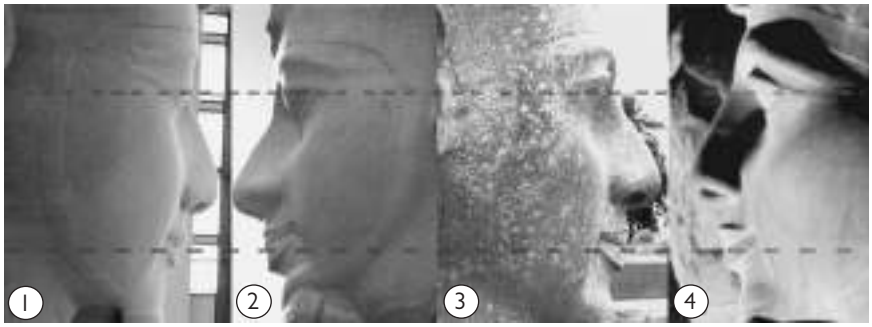


Figure 3.4. The four Ramses statues: (1) Ramses in the open-air museum at Memphis; (2) Ramses bust from the Ramesseum; (3) Ramses bust outside the Temple of Luxor pylon, taken with the camera facing west; (4) Seated Ramses in the Ramses Hall in the Temple of Luxor, taken with a telephoto lens and with the camera facing east, from the Sharia al-Corniche outside the temple.

graphs of the bust of Ramses at Luxor were taken with Ramses' head at ground level. We see Ramses at Memphis along his length, and the mouth seems to be turned in a downward arc. As we can see in figure 3.4, when viewed from the side, each of the Ramses statues—at Memphis, Luxor, and the Ramesseum Ramses—has a mouth that curls up in an exaggerated smile.

Initiates who entered this temple of learning would see an affectionate gaze and normal smile on the lips of Ramses. As they approached the front pylons of the temple and passed through into the Ramses Hall, they would look up at the faces of Ramses and see that they were being observed.

Not only is the mouth designed to appear normal from below, but also the eyes were crafted with the same consideration as the smile. Their geometry is such that they appear normal when viewed from below. Full of challenges and surprises, Ramses in figure 3.4 clearly presents us with another technique of its creators: the top eyelid is pushed forward, giving the appearance of an eye that is looking down rather than straight ahead, while the head remains erect. And why wouldn't this godlike statue give an appearance of love and caring? Why wouldn't he smile down at the temple's initiates, as they gathered to feed their spirits and

luxuriate in the majesty of inspired science, engineering, and craftsmanship that is the Temple of Amun-Mut Khonsu?

From a manufacturing perspective, in the case of the Luxor bust, it appears that the geometry of the face was contoured and finished before the lips were cut with a different tool that followed a different tool path in order to profile the lips with precision—though not quite dead center to the face. We can discern a small radius where the lips meet the vermilion border (though this is more distinct on the Ramesseum Ramses). Intriguingly, the depth of cut increases beneath the uncommonly sharp and distinct philtrum. In figures 3.5, 3.6, and 3.7, the level of precision is greater in the Egyptian Ramses than in the Greek statue and, perhaps, dimensionally superior to the perfection of a woman's lips.

A colossal granite statue of Ramses II towering 60 feet (18 meters) once greeted the ancient Egyptians as they walked through the Temple of the Ramesseum, the mortuary temple of Ramses II. The temple is situated on the west bank of the Nile where the statue was felled by forces unknown and the torso and head separated from the body, which now lies supine within the temple walls. The bust weighs more than 7 tons and is dated from around 1270 BCE. A photograph of this statue, plate 8, shows the shape of the mouth from below. As the ancient Egyptians intended, from on high, Ramses is smiling down on pilgrims in the temple. As you can see, the mouth appears natural.

It is evident in plate 8 that the Ramesseum Ramses has equal, if not more, exact symmetry than the Ramses at Luxor. The geometry of the face is changed, and the question may be asked if this is because the two Ramses were made differently. At this juncture, it is difficult to say without a more detailed examination because of the difference in the camera angle when each Ramses was photographed. When we perform the reverse transparency overlay and bring all the facial features together, however, it is clear that the Ramesseum Ramses was crafted with the similar geometric patterns and with remarkable symmetry from the tip of the nose to the ears and moving along the skull to the upward curve of the Nemes crown.

Figure 3.5. Jessica's perfect lips

Figure 3.6. Imperfect lips

Figure 3.7. Lips that are too perfect?

Figure 3.8. Shadow of the Ramesseum Ramses

When I further investigated the symmetry of the jawline, I drew a line to bisect the head midway between the jaw. The photograph was expanded to five times the size of a human head, and then I made measurements using the measurement tool in CAD using 2 decimal point precision in inches. Figure 3.9 confirms that the geometry of the Ramesseum Ramses is more precise than that of the head outside the Luxor Museum.

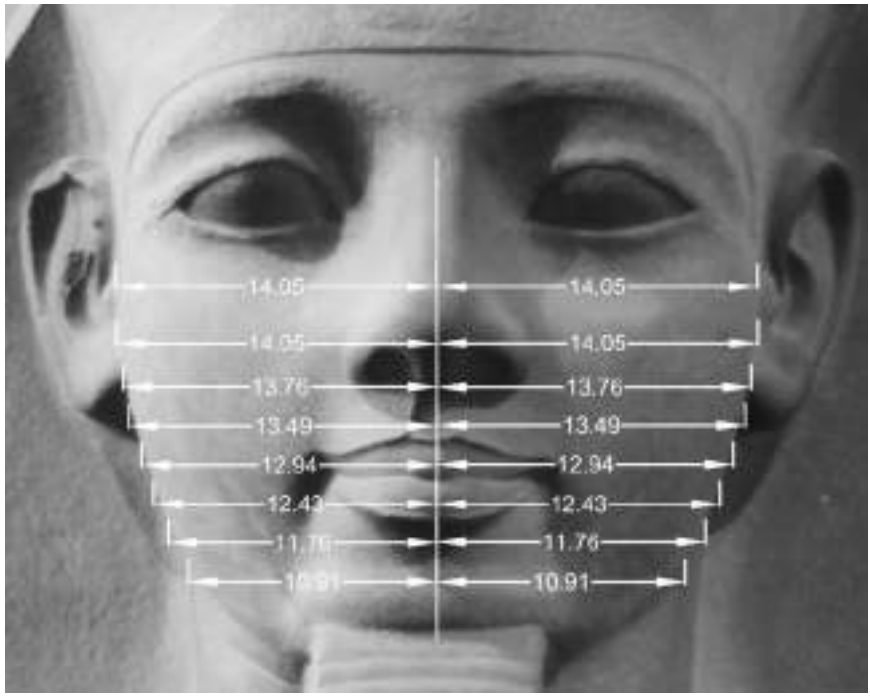


Figure 3.9. Measuring the face of the Ramesseum Ramses

The design protocol described in chapter 2 seems to be evident in all the Ramses statues. Surely, the implications of this discovery would prompt another study to coax from the Ramses statues all three-dimensional measurements from which accurate models could be created and analyzed further, yielding even better results.

WITNESS TO A SMALL MISTAKE

Ramses' smile in the statue of Ramses from the Ramesseum may appear innocent enough, but the mouth is loaded with silent information regarding a manufacturing mistake and the work that was performed in an attempt to correct it. Figure 3.10 shows this close-up. As in other Ramses faces, it appears that when the statue was created, the contours of the face were crafted first and then another tool was employed to cut the contours of the lips, leaving an unnatural cusp

at the vermilion border. In fact, it would appear that for some reason, the lips on the Ramesseum Ramses were cut deeper than necessary, particularly when we compare them to those of the Luxor and Memphis Ramses heads shown in figure 3.4. This detail is not present on the statue of Ramses at Memphis—perhaps because the Memphis statue was crafted from limestone instead of granite, which would make it easier to remove material in order to smooth the cusp. On the other hand, when the heads sat 40 feet, or 12 meters, in the air, these mistakes would be imperceptible to visitors and, therefore, not considered important. They do, however, become more pronounced when we study them in closer detail out of the context of the overpowering majesty of a grand temple.

In figure 3.10, we perhaps find a reason for the lips being cut deeper into the face. In the corner of the mouth on the left side of Ramses' lips is an undercut that gives him an almost snarling appearance. This is

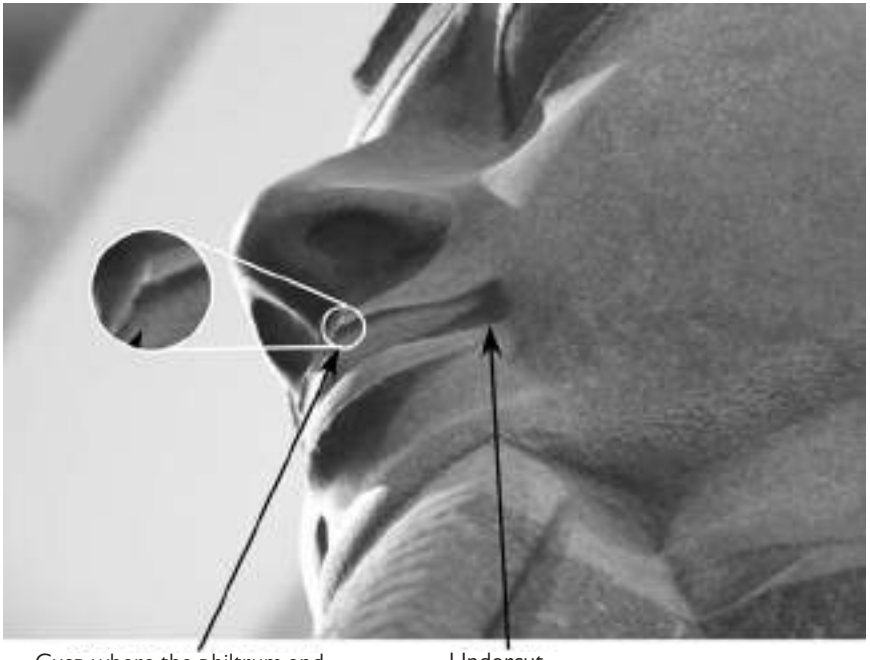


Figure 3.10. Ramses' mouth

clearly a mistake in the crafting of the mouth, but what does the mistake imply? From a manufacturing perspective, this undercut is obviously the reason for the lips being cut deeper. It seems this was done to remove as much of the mistake as possible without going too deep into the face. If the craftsmen had pushed the contours of the lips uniformly into the face in order to remove the undercut entirely, the margin between the vermilion border and the lips would be even more unnatural and bizarre looking. Moreover, this would have taken much more work to accomplish. As it is, the cusp is overlooked by casual observers—including me, until I started to examine the photographs in greater detail in my computer. What is more startling to me and to others who have performed work in brittle materials is the uniformity of the lips and, though they are cut deeper into the face, the existence of the cusp that is so sharply defined without significant crumbling of the edge. This point alone may cause us to wonder what kind of tools the ancient Egyptians possessed. It does not seem possible that such a mistake could result from the slip of a stone chisel. The undercut and the cusp on the Ramesseum Ramses point clearly to a previously unknown method of stone cutting in which a substantial amount of material is removed by mistake—and without being noticed.

When we examine a close-up of the Ramses statue at Luxor, it appears that the lips are similarly crafted, though not cut as deep into the face as on the bust of the Ramesseum Ramses—and without the mistaken undercut. Intriguingly, we can see a faint tool path that follows the contour of the upper lip from the nostril to the vermilion border on Ramses' right upper lip. Associated with these lines appear to be several cuts that are slightly deeper, causing a ripple effect at the border—but this observation deserves more investigation and cannot be considered conclusive at this juncture. Nevertheless, the irregularity at the vermilion border seems fairly conclusive, especially as seen in figure 3.11, where the shadow from the light reveals the variations. On the other hand, Ramses' left lip, seen in figure 3.12, has a shadow that is consistent with the graceful arc of the lip that keeps the light from shining onto the upper lip.

Figure 3.11. Detail of right vermilion border

Figure 3.12. Detail of left vermilion border

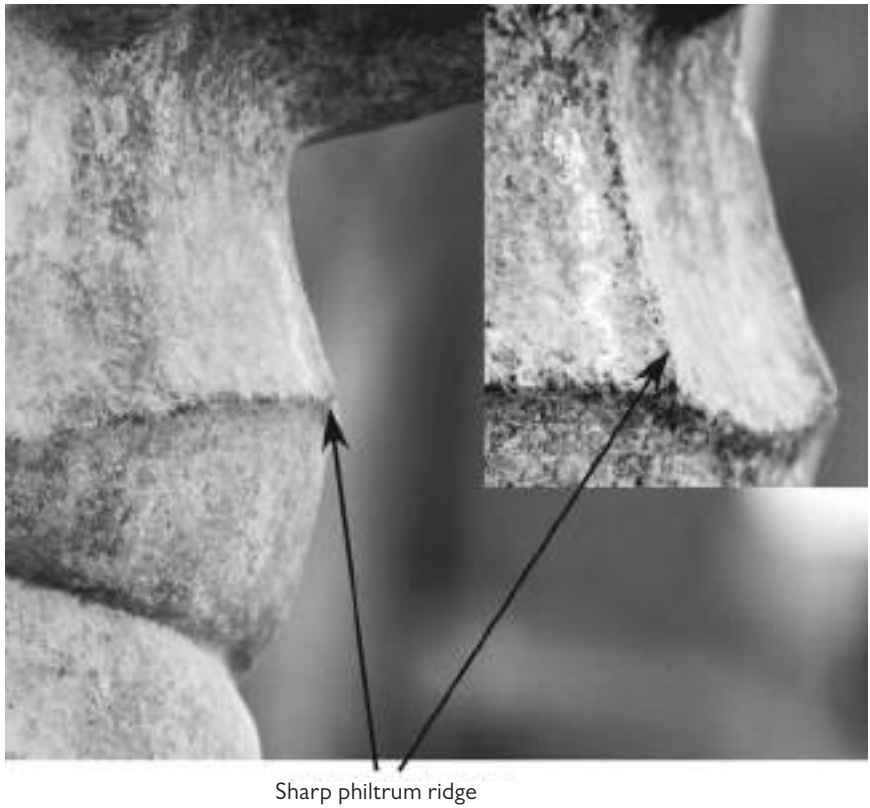


Figure 3.13. Tool marks on Ramses' mouth

If we examine the upper lips more closely, faint marks left by a cutting tool (witness marks) show that a mistake was made on Ramses' right lip, causing a jagged edge at the vermilion border, but his left lip was shaped accurately—though there, too, we can detect faint witness marks of the tool that cut the contour from the nose down to the border (see figure 3.13).

For purposes of displaying here the best evidence possible, this was too tantalizing to ignore. I had previously traveled to Egypt specifically to photograph the Ramses heads to determine their symmetry, which demanded a technique that did not include zooming in on small sections of the head. I needed the entire head in my viewfinder. Yet with the ability to take high-resolution photographs, what appeared to be

tool marks became evident when I zoomed in digitally on my computer. It became clear to me while writing this chapter that in order to finish it properly, I had to make another trip to Egypt. The digital zooms were intriguing, but I could obtain better photographs using optical zooms with a macro lens. I would then have high-resolution, close-up images with greater detail and clarity.

In chapters 1 and 2, we learned that if we are to accept Ramses' challenge to create another just like him, in simply creating the head and crown alone, we are faced with an enormous task. These, however, are only a small fraction of the entire statue. As we have learned, the seated statues at Luxor are approximately 40 feet in height, and the raw block from which each was made must have weighed up to four hundred tons. The head is a small representation of the fine craftsmanship that fittingly swells modern Egyptians' pride in their ancestors.

For our study, it is bittersweet fortuity that a head was available for close study, but I would certainly not have enjoyed being in the vicinity when it fell to earth. The forces that caused it to separate from the body must have been enormous—for one characteristic of the Ramses statues is their "unnatural" appearance because they are controlled by engineering considerations that must take into account strength and stability rather than anthropometric accuracy. The arms and legs of Roman and Greek statues do not have the same substantial connections to the principle mass of stone that Egyptian statues have, and therefore, they are more natural in appearance. The standing statues in the Ramses Hall do not have arms and legs that separate from the body. They are cut more in *alto relievo;* the body of each statue is carved out of and is firmly a part of a sturdy pillar, a gargantuan rock. There is no separation of any appendage from the torso or the pillar.

The Nemes crown, which is adorned with a *uraeus* (cobra), is more of a headdress than a crown, and most statues have this feature. From an engineering viewpoint, the headdress serves to give stability and strength to the head, because it provides mass by being integrally a part of the body, flaring outward to span the width of the shoulders. Stability and strength at the front of the neck is provided by the false

beard, which is firmly attached to the chest and provides a buttress to the chin. With the characteristics of a bas relief, the ears are a part of the head and the Nemes crown. False beards were worn by the pharaohs of Egypt because they were believed to provide them with godlike powers. The false beard on all the statues in Egypt are carved from the native rock, just like the rest of the statue.

In the standing statues, native rock connects the pillar to the back of the legs. In figure 3.1 (see p. 68), we can see that a little added symbolic support to the pharaoh's outstretched leg is given by his wife, Nefertari, who appears to be naked, but because of the smoothness around the groin, may be depicted as wearing a seductive, diaphanous garment. Figure 3.14

Figure 3.14. Nefertari's gown.

seems to clarify this conjecture. Note in figure 3.1 that Nefertari also has a web of granite between the back of her leg and the back pillar.

The seated statues of Ramses have modified arms that allow the forearm to rest unnaturally on the thigh. A human's elbow and forearm does not rest on the thigh when a person is seated upright with his hands on his knees. By adding length to the upper arm and mass to the forearm, the designers eliminated a potential weak spot in the statue, and they firmly attached all elements of the body by leaving webs between arms and chest, and legs and pillar.

Seemingly, the ancient Egyptians were more focused on engineering strength and efficiency than on creating true-to-life statues. The forearms and the hands of the seated Ramses are relatively smooth and devoid of natural human features, such as knuckles on the fingers and the toes.

The absence of knuckles on the fingers and toes of Ramses is more pronounced when we compare him to the statue of Constantine, now on display in an interior courtyard at the Musei Capitolini, Rome.

From its head to its toes, Ramses presents a unique challenge to modern engineers. How would we replicate such a piece of art? While there are areas of the statue that are asymmetrical, they do not detract from the places that are. If we had a statue that was more humanlike in appearance, with natural variances between left and right, the challenge would be easier—we could rule out the need for extreme precision and the tools and engineering considerations that go along with it. As it is, the symmetry between both sides of the face epitomizes and summarizes the most difficult aspects of the challenge.

To gain an understanding of what we are faced with in trying to replicate the statues, we can select a familiar item in the home or office—a computer mouse, a telephone, a CD player or radio. These are symbols of modern technology. If we were asked what technology they symbolize, we would probably answer "communication" or "entertainment." They certainly symbolize these two; more meaningful to me is that they symbolize the evolution of manufacturing.

◀ Figure 3.15 (opposite). Seated Ramses

Figure 3.16. Ramses absent his knuckles

Figure 3.17. Ramses' toes

Figure 3.18. Constantine's toes

If we study these items closely, we note that they have smooth contours with geometries that blend to create a three-dimensional shape that is pleasing to the eye. For functional engineered devices, however, this kind of contouring was not always the case. When product design and development were in the hands of engineers who accessed their left brain more than their right brain, all kinds of monstrosities were created. We may remember some of the original appliances that were developed to make our life easier—but for those who don't recall, there

are museums and books to teach us of these baby steps toward what we enjoy today. An old steam iron or vacuum cleaner has engineering functionality, but compared to what is available today, neither may appeal to our artistic sensibilities.

Since the dawn of the Industrial Revolution, the evolution of manufacturing has reached a point where the poorest quality product that comes to market today is vastly superior to the finest quality that was available one hundred years ago. Machines and manufacturing processes have been perfected to the point that many of the variables and imperfections that used to appear randomly have been all but eliminated. We take them for granted, but high-quality, inexpensive consumer goods were not always available.

Influencing the evolution of manufacturing all along have been artists who were employed to exert their influence on consumer products quite simply to make them more visually appealing and feed the desire to buy more products. As a case in point, a Bang and Olufsen phonograph turntable has been exhibited in the Museum of Modern Art. To put it bluntly, it was the desire for profit that forced the evolution of manufacturing. Behind this desire for profit, however, were the desires of the population to have in their possession creations that gave them pleasure—whether from making their lives easier or impressing their friends and neighbors with their latest acquisitions.

For most people today, the science and engineering behind a product is subordinate to its visual appeal. Little notice is given to how a device works—to how electrons move through circuits and cause motion such as sound or how energy moves through cavities to produce motion such as propulsion. Shapes and colors that appeal to the right brain overpower the analytical left-brain function in the majority of people and are usually the deciding factors when we select a product for purchase.

Yet even if we ignore the functionality of a product, its external appeal still speaks of technologies that are employed in its creation. We probably have, within arms length, numerous examples of high technology. A soda can or a water bottle exhibit evidence of some of the processes necessary to make them. The roundness and uniformity of a

drink container clearly indicates the use of a lathe. By studying a water-bottle top, we can discern the action of an injection mold that, when separating from the plastic, has to turn slightly in order to clear the helical screw threads. Examine your cell phone and wonder how such a product came to be. It is a perfect example of science and technology as well as manufacturing excellence. The book you are now holding in your hands came into existence through the function of machines—through wonderful examples of manufacturing precision that have evolved over the centuries.

RAMSES' SYMBOL

The Temple of Amun Mut Khonsu has inspired philosophers to try to understand the symbolism behind its walls. R. A. Schwaller de Lubicz discerned a structure that by its design and dimensions symbolized a connection with the cosmos. It is a structure that conveys principles of harmony found in music and art. The Golden Ratio and dimensions of harmonic intervals are encoded in the walls and columns through their placement and the application of reliefs. Schwaller de Lubicz stressed that the ancient Egyptians had a sacred science in which there was no distinction between the material and the spiritual. They believed both worked in harmony.

For me, the symbolism in the temple was that the statues of Ramses reflected the state of the art that was present at the time they were created. The question, therefore, is this: What minimum requirements must be met to produce a statue such as those of Ramses? To answer this question, we first must consider the most difficult tasks to accomplish, both in design and execution—perhaps, re-creating the head and replicating its geometry and precision. Once we have decided how this could be done, knowledge of the production of the rest of the body will follow. To re-create the head, we would have to design and build a means of mirroring one side of the face in order to create the other. Perhaps we could create a model and a pantograph-type device with a stylus that could follow the contours of a model while cutting the gran-

ite. That may solve how the granite was cut, but then we are still left with how the model was made to such exacting standards.

The statues of Ramses are exact. Using computer graphics and comparing the geometry of one side of the crown and head with the other and also with drafting elements such as rectangles and circles, it becomes clear that these statues must have been cut with the assistance of mechanical devices that caused the cutting tool to move along predetermined boundaries to produce an accurate representation in granite of the specific design. The only remaining question: To what quantifiable measure does the right side of the face vary with the left? In other words, after further analysis using laser scanning equipment and comparing both sides, to what extent will they vary?

Figures 3.19 and 3.20 illustrate two-dimensional grids that would produce in three dimensions a point cloud—that is, every point on the right side of the face would have an identical point on the left side of the face. We assume a point lies where each horizontal line on the grid crosses a vertical line. This point is projected on the contour of the features of the face using Cartesian coordinates. When the tool has finished cutting, with regard to the jawline, we can see a perfect radius in the two-dimensional view and, creating that radius, a curve moving in three dimensions.

Figure 3.20 represents a simple cross section of the Ramses head at the tip of the nose, the *x, y, z* zero point as identified in figure 3.19 and figure 3.20. With the nose now turned up, the *z* axis is now vertical and the *y* axis would be represented by a line moving away from the observer and graphically represented as a dot. In other words, the head has been rotated 90 degrees around the *x* axis seen in figure 3.19, and a vertical flat plane has been established through the tip of the nose. The profile was created by drawing the right side, then copying the profile in mirror image. Sectioning the head in this way, in 1-inch increments along the *y* axis, would result in many different profiles and an infinite number of profiles in between. These are the constraints we are faced with when we attempt to understand how the head of the statue was designed. We can only wonder at how these profiles were applied to granite.

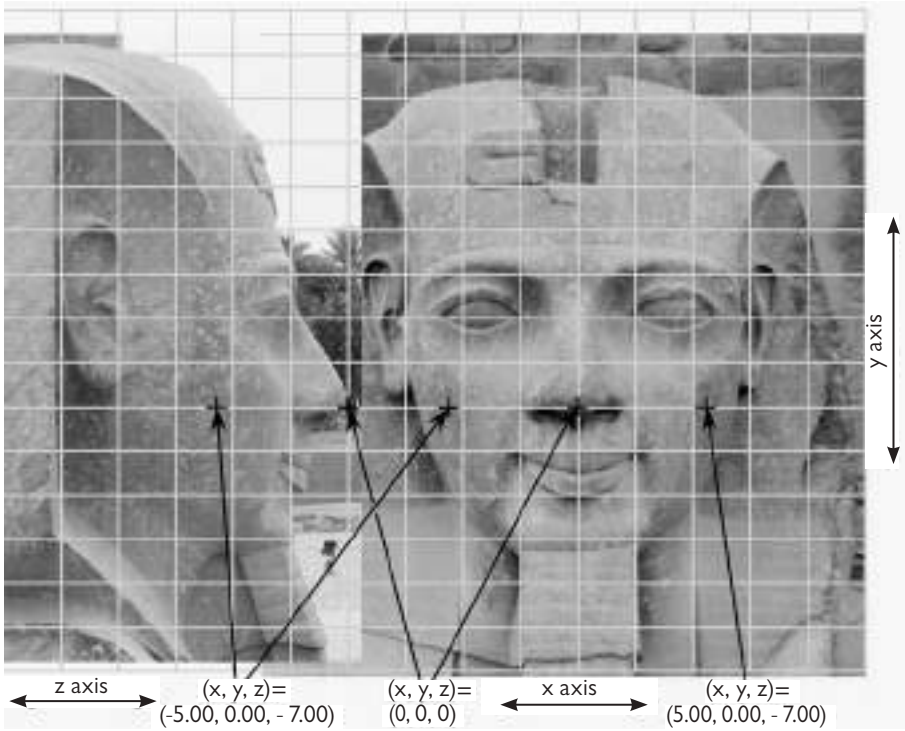


Figure 3.19. Charting Ramses' face

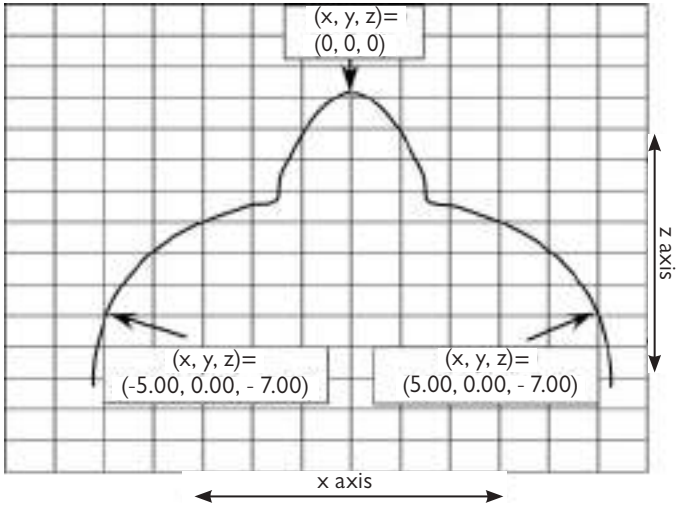


Figure 3.20. Cross section

Historically, the quality of products has improved over time, and consumers of those products—you and I—would not tolerate the quality that was commonplace even fifty years ago. Some manufacturers have gone out of business by not being able to improve operations enough to compete with higher-quality and cheaper products. If we draw a parallel between the precision of the Ramses statues and the precision of modern products, we are faced with Egyptian artifacts that conformed to specific standards of design and measure in their world. In other words, the Ramses statues had to have received similar attention with respect to geometry and exactness as the automobile in your driveway. In fact, without receiving such attention, they could not have been made.

The questions we must ask the Ramses statues are these: "What do you truly represent? What tools did your maker have to allow him or her to create you?" It is one thing to draw a circle on paper, but it demands extraordinary attention to define in granite a circle that moves along a third axis but that, when viewed in two dimensions, is a perfect radius. We have the technology to do it today—but what may have existed in ancient Egypt? Besides Ramses' head, what other indications are there that Egyptians in a long-past epoch had similar advanced technology when all we have found in the archaeological record are simple tools? Is there evidence of such accuracy elsewhere in Egypt? What conclusions can we draw from other temples? Or is Luxor an anomaly and a miracle of superhuman touch guided by the gods? This is not an uncommon conclusion. It is often reached by many a confounded visitor to the miracle that is the Temple of Amun Mut Khonsu.

THE COSMIC EGG

Proverbs were an important part of the ancient religion of Egypt. A concept that was burned into the Egyptian philosophy was "know thyself." Ancient Egyptians were reminded of the spiritual aspect of this concept when they visited their temples—that is, the divine essence of the Creator and the heavens was encoded within them. The Egyptians' heart was their temple, and all the Egyptians needed to

Figure 3.21. Ramses' egg

learn about the universe could be found there. The expression was inscribed on the temple walls, and the ancient Egyptians also took it with them to the afterlife by having it inscribed in their tombs: "The kingdom of heaven is within you; and whosoever shall know himself shall find it."

4

The Shadows of Karnak

We read the past by the light of the present, and the forms vary as the shadows fall, or as the point of vision alters.

James Anthony Froude, *Short Studies on Great Subjects Vol III. Society in Italy in the Last Days of the Roman Republic*

Figure 4.1. Monolithic trunkless legs of hewn granite at Karnak

The quotation illustrates the conflict that can arise when we study the shadows of a photograph. Using shadows to form conclusions presents a double-edged sword. Though a clearly outlined geometric shape that is free of shadows and is taken in the full light of day provides substantial evidence to form an analysis, shadows can either be your friend or they can be misleading. For instance, the shadow that light throws on the upper lip of the Ramses statue (as shown in figures 3.11 and 3.12 on p. 80) reveals a difference in the smoothness between Ramses' the upper right and the left lip. To state more than what is obvious in the photograph would be to read more into your analysis than there is. Similarly, the parallel striations that we can see on the upper lip and the philtrum in figure 3.13 (see p. 81) are not the best evidence to conclude that the tool that cut the statue followed these particular paths. On the other hand, to achieve the symmetry and precision found on the statues, the craftsmen's tool had to have a precise geometric path to follow. Perhaps, then, these telltale witness marks or "ghost" marks can actually provide us with evidence of the method of manufacture. If so, more of them may be found if we look closer.

It is estimated that the Parthenon in Athens took ten years to build. Rebuilding efforts of portions of the temple that have suffered the ravages of natural and human forces have been ongoing painstakingly for the past thirty years. A shadow thrown across the cusp of the fluted columns of the Parthenon provides information regarding the geometry and precision with which the flute was cut. The restorers of these columns carefully scrape and chisel the flutes after a specially made machine has cut the flutes in replacement sections. Why? Because the machine could not replicate the ancient technique. Senior science editor of PBS's *Nova,* Evan Hadingham, writes:

> Today's restorers have been replacing damaged column segments with fresh marble. To speed up the job, engineers built a flute-carving machine. The device, however, is not precise enough for the final detailing, which must be done by hand. This smoothing of the flutes calls for an expert eye and a sensitive touch. To get the ellipti-

> cal profile of the flute just right, a mason looks at the shadow cast inside the groove, then chips and rubs the stone until the outline of the shadow is a perfectly even and regular curve.[1]

No records exist that explain how the ancient Greeks built their temples, but modern attempts to replicate their achievements inspired Mr. Hadingham to ask if the original builders had better tools than today's artisans.

Similarly, no credible records explain how the ancient Egyptians built their temples, and we could ask the same question of them that is asked about Greek artisans: What tools did the ancient Egyptians use to craft their statues? If we listen to conventional archaeologists, we might conclude that they used a combination of round and straight copper saws charged with abrasive sand, stone hammers, and stone chisels to cut granite. All of these tools were wielded using the energy, skill, and eye of human artisans. But the geometry and symmetry of these statues raise a troubling question about the efficacy of these ancient tools. To be certain, they have been demonstrated to be capable of removing material and shaping hard stone such as granite,[2] but not to the level of precision and sophistication that we see in a Ramses statue.

In today's manufacturing shops, some products can be machined to desired geometric tolerances without requiring that the marks left by the tool be removed by a secondary process, such as polishing. Any process whereby a tool affects material along a defined path will, without polishing, leave witness to the path of the tool. The tool might be a three-dimensional printer, building discrete amounts of plastic material in thin layers to create all manner of three-dimensional shapes, or a rotating tool bit that cuts material along a geometric path that's defined by mathematically and incrementally slicing a three-dimensional object along one of its axes. If we are driven to the conclusion that the symmetrical accuracy of the Ramses statues could be achieved only with the assistance of mechanical axes that guide the tool along a predetermined path, then the striations found around the eyes (see figure 4.2) would not be surprising. These marks follow a path that a guided tool would

Figure 4.2. Signs of a tool's path on a statue of Ramses?

follow to create these features. We should also note that these marks are not visible to the naked eye, but instead were captured by a 15.2 megapixel camera using an ultraviolet filter.

If we speculate that these marks were secondary to the handcrafted creation of the piece, then we might wonder what created them and why. Are they water stains left on the surface of the granite after a downpour? Or are they inherent features of the granite? To answer these questions, we need to understand what modern tool marks look like and then compare them to those on the Ramses statues. Moreover, if the methods for creating the geometry of the Ramses heads used a tool that was meticulously controlled through mechanical means, then the method would have been used on other statues.

Figure 4.3 illustrates two types of tool marks. Inset 1 shows the surface of a conical steel die that was cut on a lathe. The witness marks of the tool are helical; the tool moves constantly along a linear path while the material rotates. Though these marks are quite clear, to the touch the surface is very smooth; we can feel no ripples. Sheet metal is formed around the shape of this die in a press.

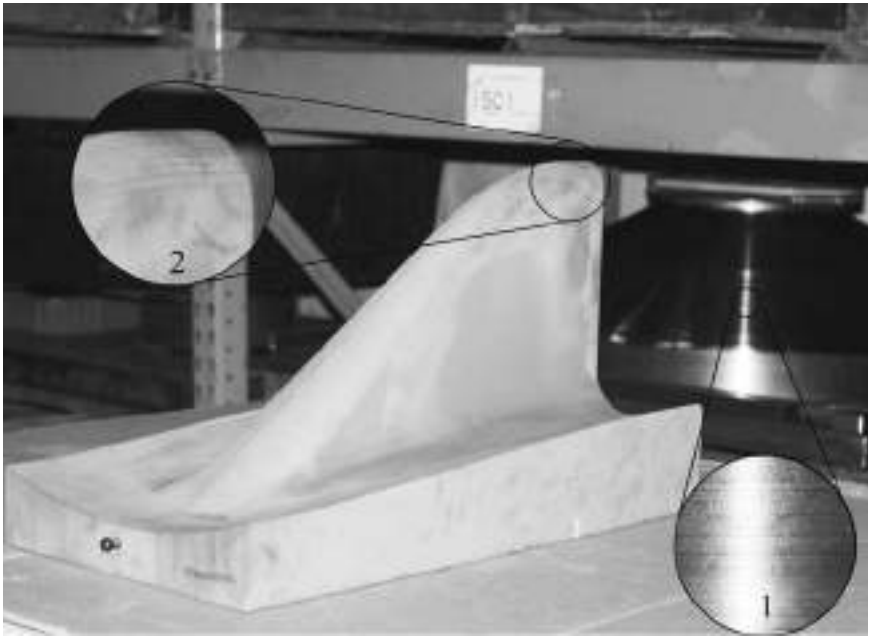


Figure 4.3. Tool paths on aerospace tools

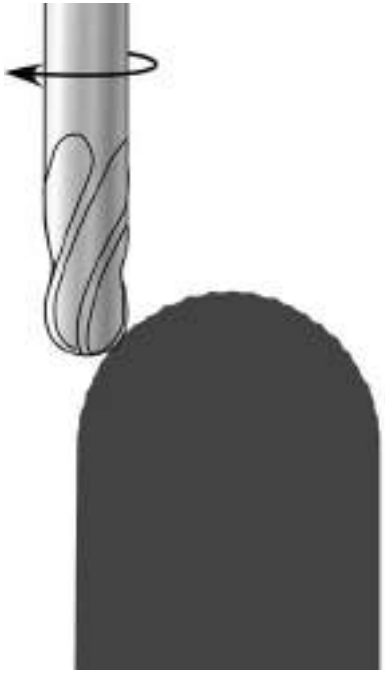


Figure 4.4. Geometry of a tool path formed by a ball-end cutter

Inset 2 shows the surface of a manufacturer's model for a jet engine part. The tool marks are more pronounced on the top of the fin—the result of a convex radius cutting a convex radius and leaving a pattern of concave cuts. Figure 4.4 shows an example of the type of surface created with multiple passes from a ball-end milling cutter that leaves a cusp between each pass. The distance between the passes could be reduced to create a smoother surface, but for the purpose of this model, it was not necessary and would have added more cost to its manufacture.

Given what appear to be tool marks on the Ramses head at Luxor, we next must study other statues to see if there are witness marks from the tools that created them. Lighting and the angle of the camera contribute greatly to the ability to see these kinds of witness marks, though this figure is not the clearest example and provides only a hint of what was discovered after we left the Temple of Luxor and visited the Temple of Karnak in the mid-afternoon on November 12, 2008.

The Temple of Karnak is a sprawling site that covers more than 247 acres. It is considered the largest temple in the world, rivaled only by Angkor Wat in Cambodia, and presents to visitors a stunning collection of monolithic pieces of stone crafted into statues, obelisks, columns, and walls. Karnak is made up of three main temples with several smaller, enclosed temples and outer temples. Construction continued on the temple for thirteen hundred years under approximately thirty different pharaohs.

The sheer volume of granite, diorite, and alabaster that was cut precisely into statues around Luxor attests to the ancient Egyptians' mastery of their craft. The Greeks and Romans did not sculpt statues in igneous rock. Granite was not fashioned into statues until the development of more modern power tools with steel bits. In *The Materials of Sculpture,* Nicholas Penny writes:

> Granite had occasionally been worked in shallow relief, for architectural ornament where it was the local building stone, and for the stiff figures of sixteenth-century calvaries in Brittany, but, before the advent of improved metals and power-driven tools in the nineteenth

century, the idea of making statues out of it was seldom seriously entertained by sophisticated sculptors.[3]

Whether using a hand-powered chisel or a power tool, shaping granite with a chisel is accomplished by percussive forces acting perpendicular to the surface of the granite. The marks left by these tools, if not polished out, are randomly scattered over the surface of the stone. Similarly, if a bush hammer (one that has nine or more hardened, pyramidal points ground into the face) is used, a mottled surface is created. Bush hammering is a common method of giving stone a rough surface—and is often used for steps in order to make them skid-proof.

The tool marks visible on the Ramses statues in the Temple of Luxor do not have the appearance of being made by chisels or hammers of any kind. So what kind of tool would the ancient Egyptians have used? Down the left side of the head of one of Ramses statues at Karnak are some tantalizing clues that may give us a clearer idea of what took place in these ancient statuary workshops. I was close to the end of my visit to Karnak when I set up my tripod to photograph the Ramses statue in the forecourt just outside the Great Hypostyle Hall. I peered through my camera lens fitted with a 300 mm zoom lens as the sun set in the west and cast its light across the left side of the face. The evening light revealed a series of striations that flowed in graceful arcs down the cheek and into the neck of the statue. Are the striations on this statue and the Ramses at Luxor simply the result of dirty water running down the statue, or are they witnesses to a sophisticated method of cutting? A close-up of the cheek (see plate 9) provides more detailed information of cusps between what may be the route taken by a mechanically guided tool. These marks demand further attention before reaching clear conclusion.

Upon examining plate 10, though, we see the shape of the tool that was most likely used to perform fine detailing on the face and around the eyebrows. At the top of the eyebrow are marks that follow a path down the crown and the brow and end at the top of the eyebrow, where it cut slightly deeper than the surrounding surface leaving rectangular

indentations. The indentations are conspicuous by the shadow on the bottom surface caused by the sun grazing across its edge in the corner, and the path of the tool is discernible in the striations that flow down the brow to where we can see the top-of-the-eyebrow indentation. There are six of these indentations, which appear to be equally spaced. Also, below the eyebrow is an area where the tool cut away part of the eyebrow. This cut is noticeable down to the eyeliner. These indentations lie along distinguishable striations that flow from the top of the brow down to the neck. These mistakes tell us that those who created the statue must have determined that the errors were not severe enough to need correcting—a logical conclusion, for they are not noticeable to the naked eye from ground level.

How did these mistakes happen? I consulted with Greg Brown, a sculptor and an editor at *The News Gazette* in Champaign-Urbana, Illinois, and he regarded the mistakes as not those that a skilled sculptor would make with the tools at his or her disposal on a sculpture of that scale. For one thing, the parallel striations down the face into the neck are not the kind of marks that would be left by a sculptor using hand tools. We both concurred that these marks have all the characteristics of machining. Further, when a tool that applies force in order to remove material along a specified path is stopped while the force is still being applied, it will continue to remove material in the place where it has stopped. In other words, if a rectangular tool that is energized like a jack hammer and that's guided along a geometric path on a piece stops moving, the tool will continue jack-hammering away at the material, causing an indentation. Given the mistakes left on the statue at Karnak during the cutting process, possible methods used by the ancient Egyptians are brought out of the shadows and into the light.

We gained a rough estimate of the size of the rectangular depressions by comparing the size of a human face to Ramses at Luxor, overlaying a transparency of the Karnak Ramses over the Luxor Ramses, then measuring the rectangles. The measurement reveals a tool size of approximately 0.30 inch (7.62 millimeters) × 0.180 inch (4.572 millimeters). From a technical perspective, these dimensions are probably

optimal for a tool that is performing finish cuts. The surface area that strikes the granite is not large, so fine detailing can be accomplished with such a tool. The tool marks show that the orientation of the tool as it made a pass over the granite provided the widest cut. That the width's dimension is greater than the height means that the distance between passes can be greater than if a square tool face was used with the same surface area.

Figures 4.5, 4.6, and 4.7 show different views of the statue and the remarkable striations that are evident from the top of the crown to the neck. Inserted in the photographs are magnifications of an area below the ear that show more mistakes made by the manufacturers of this

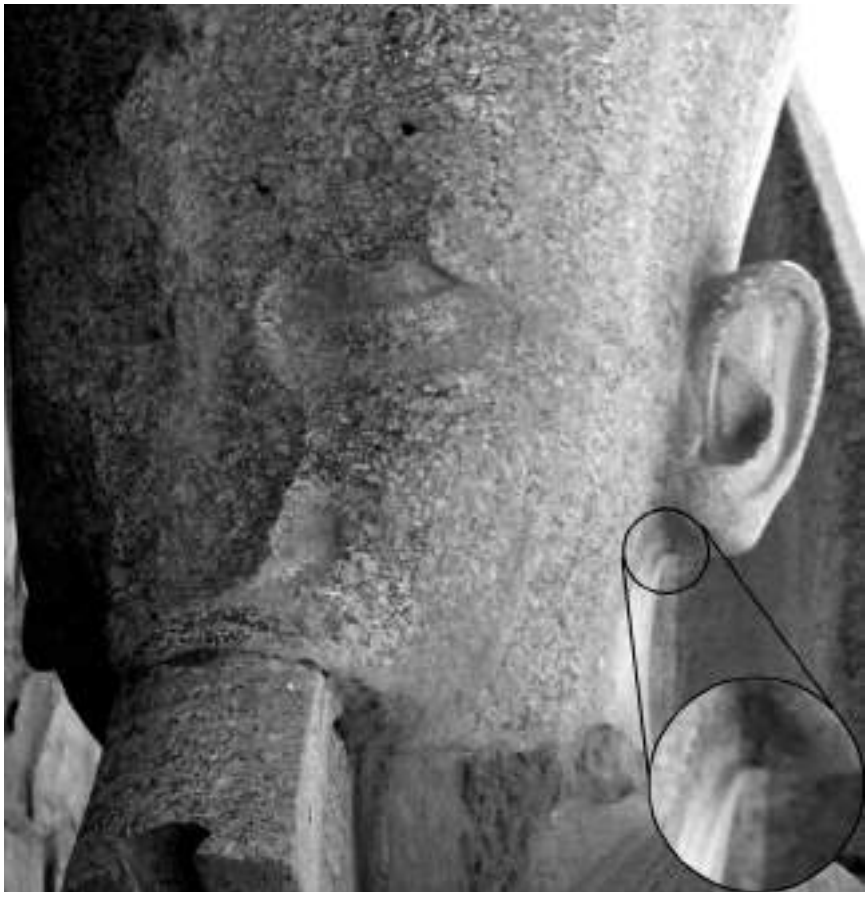


Figure 4.5. Karnak Ramses' tool marks beneath the ear from the front

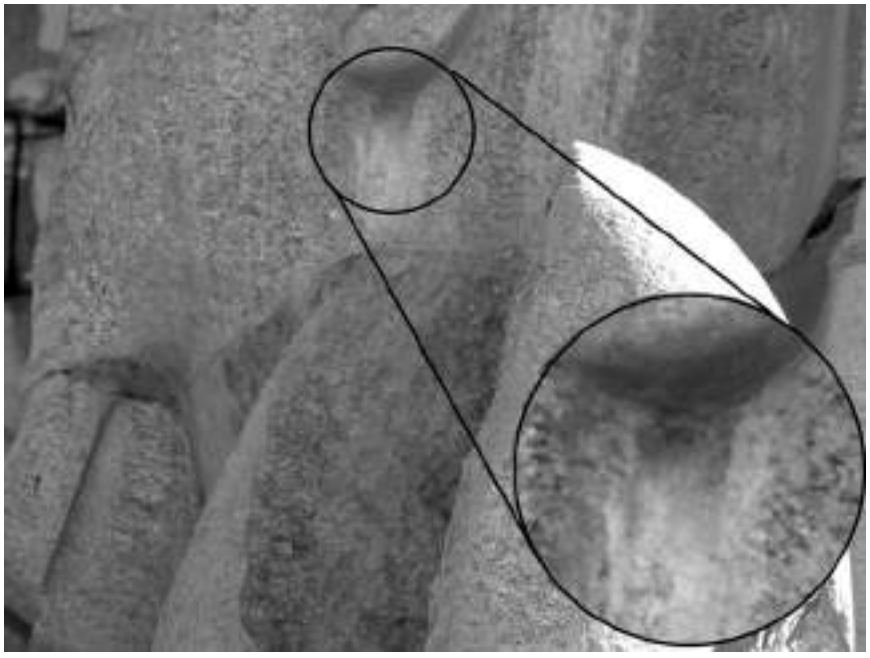


Figure 4.6. Karnak Ramses' tool marks beneath the ear from the side

piece. They say that the devil is in the details and these details raise some thorny questions. Branching from the fundamental question of "why?" we can ask: What extra effort went into creating these mistakes? We might conclude that usually, a sculptor who shaped a piece of granite into a human head with a hammer and chisel would expend enough effort to reduce the material to the required shape, and then would have only to polish away the tool marks. There doesn't appear to be any logical reason for a sculptor to make and leave these marks of superfluous cutting in such a hard material. These are more than a slip of the chisel and may be more the result of an unattended machining process than the work of a proud and highly skilled sculptor.

Introducing the concept of machines capable of performing this kind of work in ancient Egypt is highly controversial. For many engineers, the product is enough to show that machines had to have been used, but to archaeologists and Egyptologists, the absence of machines in the archaeological record is enough to say that all these works were

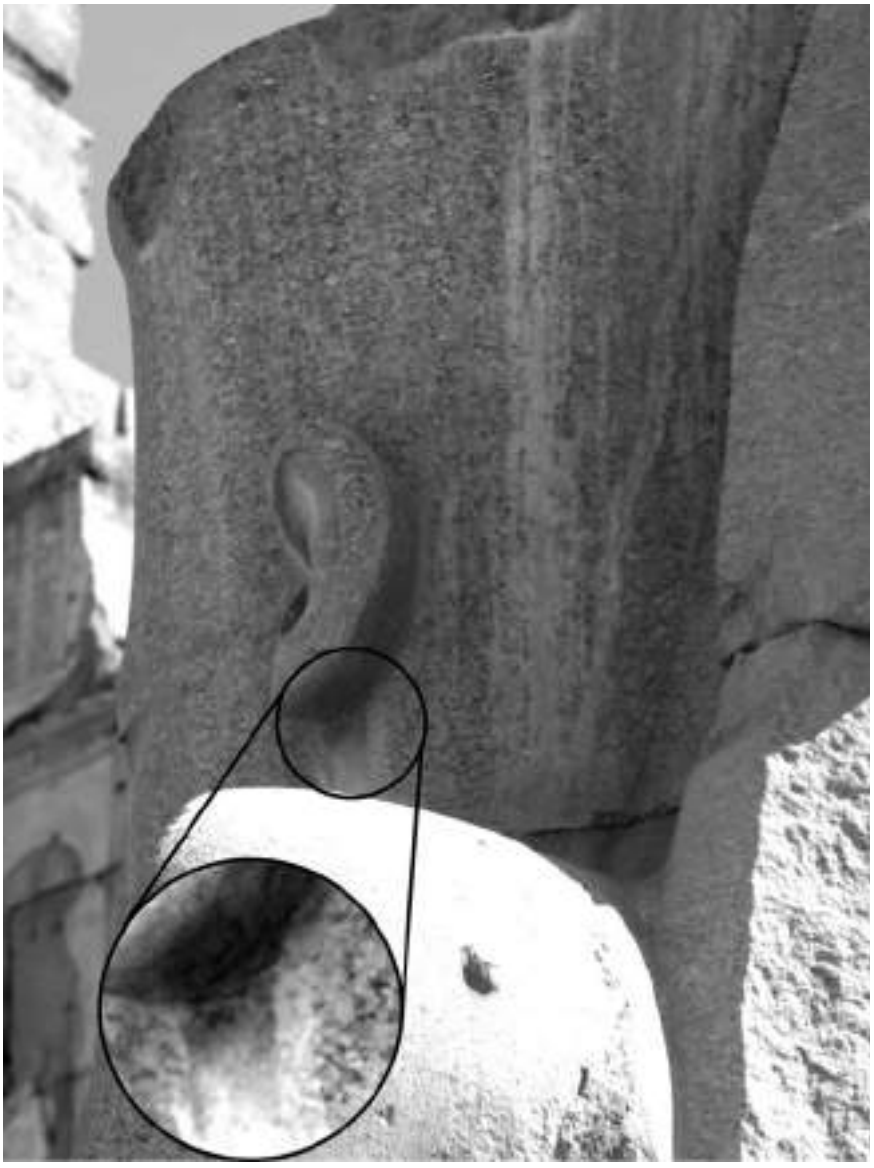


Figure 4.7. Karnak Ramses' tool marks beneath the side-rear

created by hand. Here, however, I present this information to provide engineers, technical people, and even interested modern sculptors with observations that they may not find in a textbook.

For those who may not be familiar with how a sculpture of a Ramses'

head would be made today, we can look at plate 11 as an example. This image resulted from a search on the Internet. Anyone with a computer can Google "tool path software" and receive hits for all manner of products that are created with three-dimensional modeling and machining software. This example is reprinted here with the kind permission of Joakim Möller, president of MadCAM Mould and Die CAM Systems, in Romakloster, Sweden. Mr. Möller's permission was freely given without knowledge or endorsement of the context within which his image was being displayed. It can be viewed at www.madcamcnc.com/Tutorials/4-axis%20demo/4-axis%20Tutorial.html.

As we can see in plate 11, the protocol for guiding a tool across a three-dimensional contour has not changed for more than three millennia. This is not surprising if we consider the geometry and precision of the Ramses heads, but this does not mean we can conclude that the ancient Egyptians possessed sophisticated computers and software that could generate code to feed into machines that in turn shaped their environment. Machines moved along exact, mechanically guided axes for many years before the advent of computer software. But as mentioned earlier, creating a Ramses head on one of these earlier machines would have been a significant challenge. Yet the evidence seems to be stacking up in favor of revising what we have been taught about the level of technology possessed by the ancient Egyptians.

Once I had a good idea of the kind of impressions the ancient Egyptians' tools left on the surface of the granite, I examined other photographs that I had taken to see if the marks showed up on other statues.

Going back to Luxor, we see that a close-up of Ramses' mouth (figure 4.8) reveals that the irregular, jagged edge along the vermilion border of the upper right lip was created by a series of cuts from a rectangular tool. A closer look at the left lip indicates that though the line is more precise, it is still the result of a rectangular tool being applied in one place before being moved over and reapplied to cut again. This is a very curious feature, because the lips themselves show no sign of "pick" marks, but instead are smoothly contoured surfaces. Only at the upper vermilion border can we see these marks. No doubt where the upper

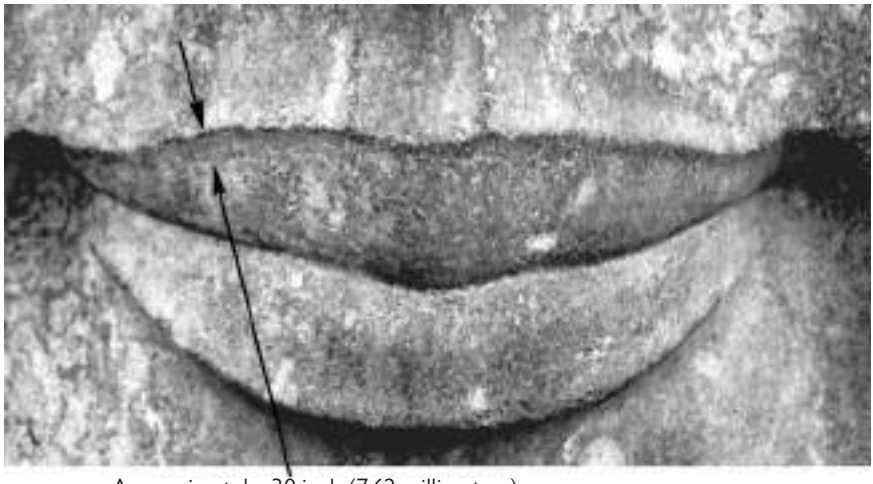


Figure 4.8. Close-up of a Luxor Ramses' mouth

and lower lips meet, the tool used was much smaller. The marks here indicate that a round tool was used to define the junction of the closed lips, with a rough estimate of the size being a diameter of 0.09 inch (2.286 millimeters). The tool probably had a bull nose and the shape of a punch. It appears that this detailing was done by plunging the tool into the granite and then moving it across the profile of the lip the distance of a tool width, and then repeating the process.

When considered with the mistake made on the mouth of the Ramesseum Ramses (figure 3.10, p. 78), a strong argument can be made that these details were applied by hand after the head was carved with larger and more efficient tools and methods. A logical sequence of steps would be to cut the geometry of the head using one program or model and a large, more robust tool that would remove material efficiently. Then, with a smaller tool use separate programs or models to cut the mouth, eyes, and ears. A close-up of Ramses' right eye with magnified inset provides more evidence of the plunge technique used to craft the finer details of the statue (figure 4.9). After these tasks had been completed, a hand tool could have been applied to create a sharper definition at the borders of the facial features—the shape of which had

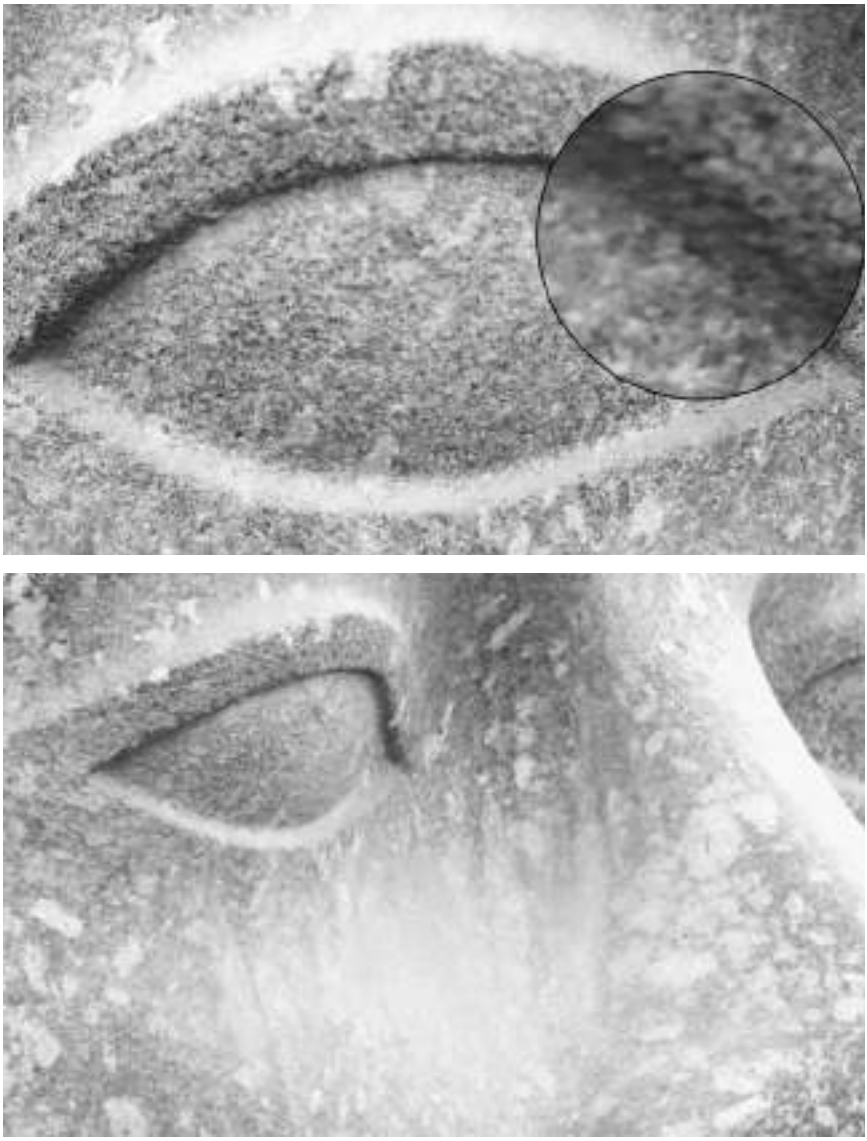


Figure 4.9. Close-up of a Luxor Ramses' eye

already been defined using mechanical assistance. A more distinct view of a cusp left between paths that the tool followed is seen in figure 4.9. Finding the mouth slightly off center with the jaw line and nose (seen in figure 2.13, p. 53) is not surprising in this scenario and may be

explained by the introduction of another tool and a reorientation of the mechanical axes with the geometry of the head.

Even if we ignore the seeming imprecision of the existence of tool marks on the Ramses' statues, we cannot ignore the exactness of their geometry. This degree of accuracy proves an important point. To achieve geometric perfection by hand involves an enormous amount of very careful grinding and polishing. Yet there are no scratches on the Ramses head that we would normally associate with grinding and polishing. Moreover, grinding and polishing would show more of the random direction of the artisan's stroke. It appears, from all the evidence that I have seen in Egypt, that the ancient artisans had achieved the net shape of their final product without leaving behind any areas that we could look at and identify as an area that required a little more polishing than another, which has long been the hallmark of crafting precision products by hand. In modern times, on the other hand, very exact surfaces can be cut on a machine, and tool marks are left to show the path over which the tool traveled. Depending on the requirements of the tool, sometimes the tool marks have to be removed, other times, as in figure 4.3 (see p. 97), it is not necessary.

While there are over one hundred known Ramses in Egypt, it is astonishing to learn that Amenophis III, also known as Amenhotep, had more than two hundred fifty statues crafted in his likeness. Once we see the exacting accuracy on one statue, we can only imagine more than two hundred fifty being created. We can imagine a production assembly line, with roughers, finishers, and fine detailers; followed up by an army of craftsmen applying deeply etched hieroglyphs and reliefs. Moreover, the execution of the design across Egypt, from Abu Simbel in the south to Memphis and Alexandria in the north, implies that a standardized system of measure and production-line manufacturing must have existed that would not be out of place in today's society.

The amount of time it would take to accomplish all of this work in igneous rock is extraordinary. The statues of Egyptian pharaohs were crafted with symmetry—as though each sculpture was a stylized representation of only their most perfect image. Was this a self-image that the

pharaohs wished their subjects to see, or was it the result of techniques that the craftsmen developed in their cloistered workshops with tools of which we have yet to gain knowledge? Ramses is not the only pharaoh with perfect symmetry. Amenophis III and most other Egyptian statues are also crafted to an extraordinary symmetry.

The dimensions applied to the outline of the jaw on Amenophis III indicate a precision of plus or minus 0.06 inch (1.52 millimeters), which on a human scale would be 0.01 inch (0.254 millimeter), or half the thickness of a thumbnail. The continuation of the use of ellipses in the design is evident in the face and crown of figure 4.10 as well as in figure 4.11.

Some of the statues I photographed, though severely damaged, have

Figure 4.10. Amenophis III from the Temple of Mut in Thebes

Figure 4.11. Red granite figure of king from the temple of Karnak with elliptical design

outstanding features that invite this kind of photographic study. While little attention is given to the ears of a statue because there are more outstanding features to look at, in studying the ears of Egyptian statues, there appears to be a mechanical precision and application of geometry in how they were crafted. A close-up of Ramses' ears at Luxor and

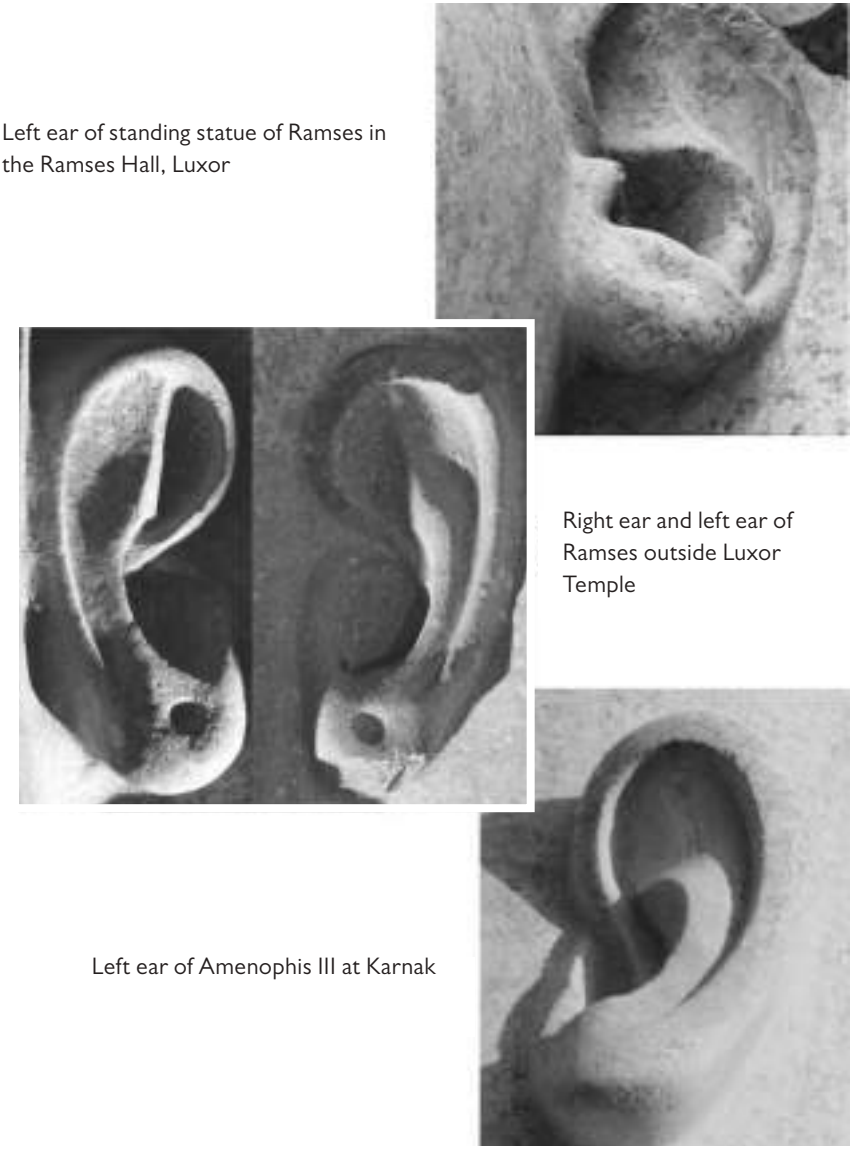

Left ear of standing statue of Ramses in the Ramses Hall, Luxor
Right ear and left ear of Ramses outside Luxor Temple
Left ear of Amenophis III at Karnak

Figure 4.12. Ramses' ears with Amenophis III left ear

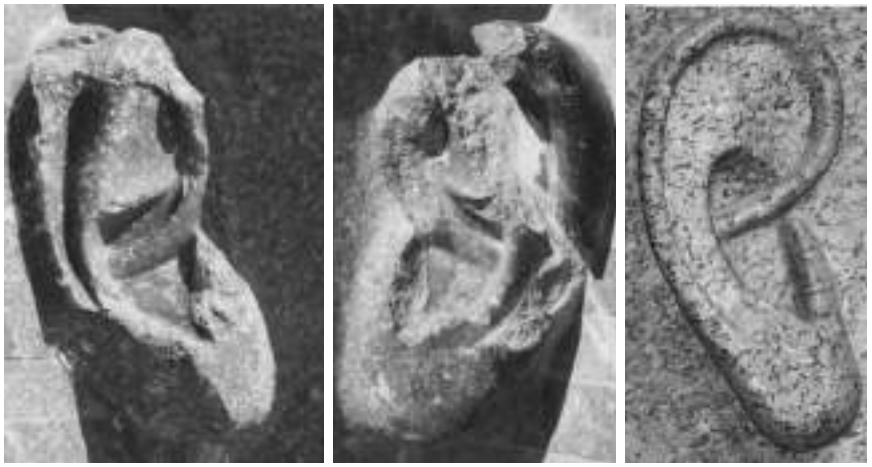


Figure 4.13. Ramses' ears at the Ramesseum with Amenophis III's ear from the temple of Mut

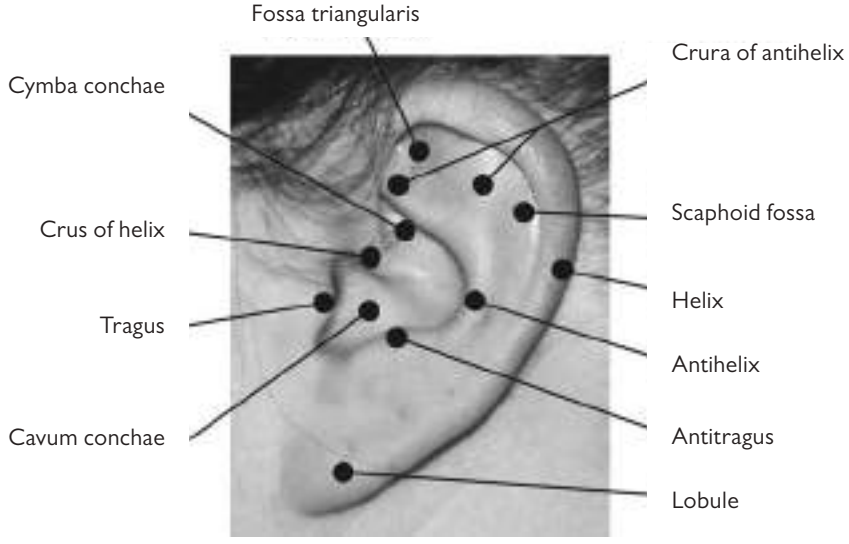


Figure 4.14. Jeanne's ear

Karnak and on the remains of the shattered bust at the Ramesseum (see figure 4.13) reveals uncommonly sharp inside corners and fine detailing. We cannot help pondering the kinds of tools employed to create these features. Though there is evidence on the Karnak Ramses statue of a rectangular tool driven against the granite (see plate 9), leaving sev-

eral depressions above the eyebrow, the shape of this tool could not have been responsible for the final finish of the ears.

The Ramses at the Ramesseum, especially, reveals inexplicable features that are not found in a normal ear. The insides of the *cavum conchae* and the *cymba conchae* come to sharp corners, whereas a normal ear is rounded in the corners. From a manufacturing perspective, if the ear was created using a hammer and stone chisel, these features would require more work to accomplish than would the rounded corner that we see in a human ear. If the feature resulted from a special tool being driven into the granite, then a tool with a small radius with a rake angle would remove the material more efficiently, because there would be less surface area to cut.

From this chapter, along with chapters 1, 2, and 3, the picture that is beginning to emerge is that the ancient artisans were more interested in efficiency than exact replication of the human form. We have studied in detail only the head and crown, but all over these ancient statues we can find examples of mechanical exactness and economical production. Features left out, such as the knuckles, along with standardized design, may suggest an intentional stylization, but they might also have been ways simply to make the already enormously difficult manufacture of a statue slightly less taxing.

Of all the statues I have studied, one shows a most perfect ear, free of damage and dirt: the only ear that Amenophis III has remaining is his right ear (see figure 4.13), which epitomizes in its simplicity of form a perfection on a smaller scale with what the ancient artisans did on a larger scale: applying simple geometry using a minimum number of circles, or radii, to create three-dimensional form.

Without quantifiable measurements, we cannot argue that the geometry and symmetry of ancient Egyptian statues were dimensionally perfect. We can only, as up to now, provide a preliminary study. What has been shown could have the effect of combining imperfections to give the impression of perfect geometry, and the process of overlaying one image with another may produce a "forced" symmetry in which features blend and appear to become one. Nonetheless, there can be no doubt that symmetry was the Egyptians' objective in creating these statues, and even if

they did not achieve perfection, they came much closer than what could be accomplished by visual comparison.

Today, archaeologists employ modern imaging tools to analyze ancient artifacts. In Thebes, archaeologists are reconstructing a colossus of Ramses II that was destroyed by Christians hundreds of years ago. Like a puzzle, hundreds of pieces lay strewn on the ground. Each piece is photographed in three dimensions on a revolving metal caster plate, then the images are analyzed in a computer and reconstructed in virtual space. This technology can record images that are within 40 microns (0.00157 inch) of the surface that is measured, and these will be used to determine the feasibility of reconstructing the colossal statue.[4]

Replicas of ancient statues have also been made using modern, computer-controlled machinery. The information that is given to the computer to create the shapes is taken from the statues themselves using laser scanning or stereo photographic imaging techniques. The results are then fed into the computer, and paths are generated for tools to follow in the machine. A replica of the bust of Emperor Constantine was created in this manner using Delcam CAD/CAM software generated from the information gleaned from the original bust in Rome.

The next likely step in analyzing the Ramses statues would be to scan their geometry into the computer to create a computer model, then bisect the head and compare one side to the other to accurately determine the variation between the two halves. From what we have studied in chapters 2 and 3, there is good reason to believe that the information gathered will contribute significantly to our understanding of our past. We might find further evidence that the ancient engineers were more like us than we previously thought.

The ancient Egyptian artisans had to have had some means of taking precise measurements. This statement becomes more meaningful when we study artifacts with less complex geometry that can be measured with simple, modern-day instruments in the field. This is where we will go next. From Luxor, we will travel to Cairo, where there is much to be learned in a mysterious underground complex near the Step Pyramid at Saqarra.

5
The Shadows of the Serapeum

Art without engineering is dreaming; engineering without art is calculating.

Anonymous

The difference between men is in their principle of association. Some men classify objects by color and size and other accidents of appearance; others by intrinsic likeness, or by the relation of cause and effect. The progress of the intellect consists in the clearer vision of causes, which overlooks surface differences.

Ralph Waldo Emerson, *Essay on History*

Before I experienced exalted vistas of granite and a rush of wonder in the temples in Upper Egypt, I undertook a descent into the shadows of what must be the most confounding and enigmatic archaeological site in the world. While the statues of Luxor and columns of Dendarah provide lift to the mind and spirit, we find a different perspective in the subterranean vaults of a temple located northwest of the step pyramid at

Figure 5.1. The entrance to the Serapeum

Figure 5.2. Entering the Serapeum

Saqqara. There is little above ground to identify these vaults except the hut of an Egyptian tomb guard (also known as a *ghaffir*) and low walls on both sides of an inclined path that lead to formidable, dungeonlike iron doors. Attached to the iron bars that form a transom light above the yellow painted doors, a sign painted in Arabic and English reads: SERAPEUM DYN XVIII PTOLEMY XII CA.1405–30 BCE.

I first visited the Serapeum in 1995 with a Canadian researcher named Robert McKenty. Since that time, my mind has returned to its mystery and the confounding challenge that it presents modern researchers. It is not on the tourists' venue because it is considered too dangerous to visit, and it is closed to the public. At the time of my visit in 1995, I possessed a precision-machined parallel that I had been using to determine the flatness of numerous granite blocks scattered around the Giza Plateau. The edge on the parallel was accurate to within 0.0002 inch (0.005 millimeter), or $^{1}/_{10}$ the thickness of a human hair.

I brought it with me on the day of our visit because Robert had asked me to accompany him to Saqqara, where, in the courtyard in front of Unas's pyramid, he thought he had discovered a piece of granite that might be the result of machining. As it turned out, the object was not exact, and there was nothing about the piece that indicated

Figure 5.3. Queen Unas's pyramid with massive casing stone

that it was machined. Above the entrance to the pyramid, however, was a very impressive casing stone that surpasses those found on any of the pyramids on the Giza Plateau—one block above the entrance passage measures approximately 25 feet (7.62 meters) long and 5 feet (1.524 meters) high. Much has been written about the casing stones on the Great Pyramid, but this was the first time I had knowledge of this massive limestone block on the minor Queen's pyramid.

Unknown to me at the time I visited the pyramid were other artifacts not too far away that would receive my attention and put my parallel to good use. It was about noon and a typical hot day at Saqqara, with the sun beating down unmercifully on our heads. We had already kicked up a great deal of sand traipsing all around the step pyramid and the associated temples and lesser pyramids, so we headed over to the Serapeum, where the Netherland Television people—who had brought me to Egypt to interview me with Graham Hancock and Robert Bauval—were filming. I was not on the storyboard today, having fulfilled my obligation in the Great Pyramid a day earlier, but I appreciated the opportunity to wander a site that is not normally visited by tourists.

First to greet a visitor who enters the Serapeum tunnels is a massive piece of granite sitting on the floor in an entrance hall. The piece is estimated to weigh approximately 20 tons and has a rough finish. To the right, a larger piece of granite sits in a dimly lit passage where there is barely enough room to get around. The rough outside dimensions of the piece are 7 feet (2.133 meters) in height, 7 feet (2.133 meters) in width, and 13 feet (3.962 meters) in length. With granite weighing 175 pounds per cubic foot, as a solid piece this piece would weigh approximately 55 tons. Peering at the top of the piece, though, I could see that the inside had been roughed out, leaving a wall thickness of approximately 1.5 feet (45.72 centimeters). With this material removed, the box weighs approximately 38 tons.

The entrance hall is larger in width and height than the tunnels where the boxes are installed. Cut into the walls are rectangular depressions that bring to mind images of large cutting tools boring into the

Figure 5.4. Roughed out box and lid in the Serapeum

rock to remove material quickly. Along their vertical length, the bottoms of some of the depressions are concave, while others are flat. Some have an arched top and others do not. The arrangement of depressions is haphazard and does not appear to conform to any particular design criteria. Egyptologists' accounts of the Serapeum speak of hundreds of votive stelae lying in the passageways or embedded in the walls: "These stelae contained dedications to Osiris-Apis and, as already mentioned,

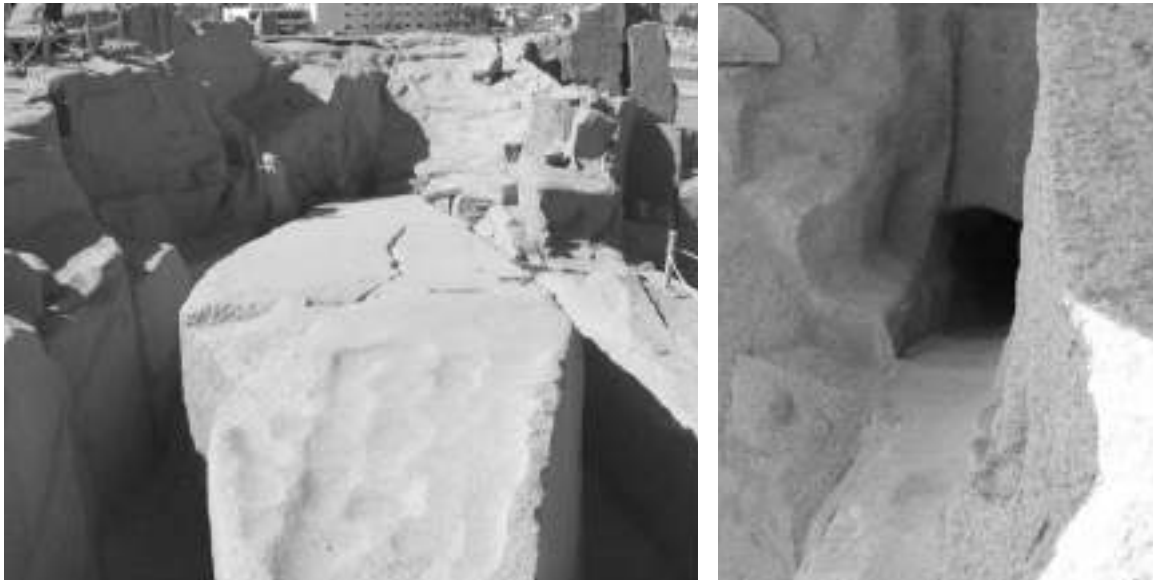
Figure 5.5. Serapeum entrance hall with rough and random depressions cut in wall

were sometimes dated by the regnal years of the reigning monarch."[1] From these stelae, scholars gathered the chronology of the site, for they provided data giving the duration of reigns from the beginning of the twenty-sixth dynasty to the end of the Ptolemaic period.

The niches in the wall are curious features and look remarkably similar to the depressions that are seen on the unfinished obelisk at Aswan. There, on the top of the obelisk and around the trench, we can see similar rectangular depressions, though these have been interpreted as being the result of bashing the area with stone balls. If we consider the discovery of votive stelae installed in these niches, it would be logical to assume that the niches were created specifically to house them. On the other hand, if these depressions were the marks left by the tunnel borers, they may have been convenient places to place the stelae, for not all the stelae were installed in wall niches, and the walls beyond the entrance hall are mostly devoid of them.

From a historical perspective of the purpose of these niches, the final analysis will surely come down on the side of the Egyptologists. The stelae have been found in situ and the tunnel boring tools have not. Nonetheless, from an engineer's perspective, they do have the same appearance as the tool marks on the Unfinished Obelisk at Aswan, and

Figure 5.6. The Unfinished Obelisk at Aswan with evident quarry marks (Photograph courtesy of Dan Hamilton)



an argument could be made that the stelae were made to fit existing depressions in the wall that were left by ancient tools plunging into the rock to carve out this mysterious underground cavern.

Though dark and dusty, the Serapeum was a welcome relief from the heat. Shadows were thrown at intervals along the numerous tunnels by incandescent bulbs, and the place appeared more mysterious because a number of alcoves or crypts were cut at right angles on each side of the tunnel. Both the tunnels and the crypts had barrel-shaped vaulted ceilings that had suffered damage over the millennia, as evidenced by places where large pieces of limestone had separated from the bedrock and fallen. Some areas were protected by wooden frames with thick plywood sheets on top. A fine dust that had been kicked up from the floor hung in the air.

In the center of each crypt there was a large granite box with a lid on top. All of the boxes were finished on the inside and the bottom side of the lid, but not all were finished on the outside. It appears that work stopped suddenly in the Serapeum, for there were boxes in several stages of completion: boxes with lids, boxes that had yet to have the lids placed on them, and the rough box and lid near the entrance. The floor

Figure 5.7. Boxes in the Serapeum

of each crypt was several feet lower than the tunnel floor. Iron railings were installed to prevent visitors from falling.

The historical explanation for the boxes in the Serapeum is that they were funerary sarcophagi that were used to hold the carcasses of the sacred Apis Bull—even though no bulls (or their skeletons) were found inside them, so it is assumed that they were rifled in antiquity.

The Apis Bull was considered to be a god by the ancient Egyptians, and the Serapeum was reputed to house the burial vaults of the Apis cult. With the passage of time and following the removal of many artifacts and dust and rubble from the site, the Serapeum probably looks different today than it did one hundred thirty years ago, and early explorers gave their attention primarily to what could be gleaned from the debris. Yet nagging questions still dwell in my mind about this mysterious, hypogeal refuge from the sandy desert and piercing sun—questions about significant details not found in the historical literature. With the debris removed, my attention was drawn immediately to the engineering of the granite boxes.

Auguste Mariette (1821–1881) is credited with the modern discovery and exploration of the bedrock tunnels that are what is left of the Temple of Serapis—the Serapeum. Mariette is considered one of the greatest explorers and Egyptologists of his era, and he was the founder of the world-famous Cairo Museum. He is credited with doing more for the preservation of Egyptian monuments and prevention of the pillage of antiquities than any other scholar of his generation. In his exploration of the Serapeum he followed on the heels of other explorers, and he notes the work of the Roman geographer Strabo, the first person to have written about the Serapeum and a recorder whose work has survived the centuries. In his *Geography,* Strabo writes: "There is also a temple of Serapis, situated in a very sandy spot, where the sand is accumulated in masses by the wind. Some of the sphinxes which we saw were buried in this sand up to the head, and one half only of others was visible. Hence we may conceive the danger, should any one, in his way to the temple, be surprised by a [sand] storm."[2]

In *Le Serapeum de Memphis,* Mariette writes with no small amount

of intensity and passion and reveals a mind that believes it is on the trail of a major discovery:

> Did it not seem that Strabo had written this sentence to help us rediscover, after over eighteen centuries, the famous temple dedicated to Serapis? It was impossible to doubt it. This buried Sphinx, the companion of fifteen others I had encountered in Alexandria and Cairo, formed with them, according to the evidence, part of the avenue that led to the Memphis Serapeum . . .
>
> It did not seem to me possible to leave to others the credit and profit of exploring this temple whose remains a fortunate chance had allowed me to discover and whose location henceforth would be known. Undoubtedly many precious fragments, many statues, many unknown texts were hidden beneath the sand upon which I stood. These considerations made all my scruples disappear. At that instant I forgot my mission (obtaining Coptic texts from the monasteries), I forgot the Patriarch, the convents, the Coptic and Syriac manuscripts, Linant Bey himself, and it was thus, on 1 November 1850, during one of the most beautiful sunrises I had ever seen in Egypt, that a group of thirty workmen, working under my orders near that sphinx, were about to cause such total upheaval in the conditions of my stay in Egypt.[3]

Mariette's workers began to excavate the avenue flanked by these sphinxes, which were carted off for display in various museums. After some wrangling with the Egyptian government over permissions, which delayed the work for several months, Mariette's workers continued and eventually gained access to the tunnels.

Apparently unknown to Mariette at the time of his discovery was the report of the Englishman A. C. Harris (1790–1869), who identified the Serapeum as the same one described by Strabo and announced his discovery in a lecture in London in 1848. Prior to Harris, a French explorer named Paul Lucas (1664–1737) published his account of a somewhat terrifying descent into the dark and mysterious tunnels in

Voyage de Louis XIV dans la Tuquie, L'Asie, Soutie, Palestine, Haute & Basse Egypt, &c. (Rouen, 1719):

> After examining this monument [the obelisk at Matariya] and viewing the three beautiful pyramids that we found on our way, we finally arrived at the pit that we were looking for. It appeared square from the outside and 12 feet in diameter and around 30 feet deep. We all went down and lit up several candles that I had brought with me. As soon as we reached the bottom, we found a hole in which we had to lie on our stomachs for about twenty feet. This first entrance was guarded by a snake that frightened us, and which we killed. If the entrance to Lake Aveine had been as frightening as the one I have just mentioned, poets could have written more dreadful descriptions of Hell that they have left us. After having traversed, with much trouble, this narrow channel, we found ourselves in a large corridor, on both sides of which one could see an endless number of pots of clay of which I have spoken, and of which the covers were sealed with mortar. There were a large number that were broken; the others were still intact: there were within these pots birds, embalmed and swathed in bands and cloth, like the mummies. The underground vault was huge and had many galleries leading to the right and to the left. It was impossible to visit them all. Adopting the strategy of Ariadne and her lover before he entered the Labyrinth to fight the Minotaur, I had brought two thousand fathoms [3,646 meters] of string, but this ran out before I reached the end of the cavern, after which we were not prepared to penetrate further.
>
> All the galleries were cut in the rock, and there were a mixture of kinds of chambers, those filled with these pots, and the others with mummies, most of them reduced to dust. I noticed in many of the niches the heads of bulls, from which I deduced that this was the place where the god Apis was interred; I have no doubt that the bull-head that was given to me for M. de Valincourt by M. le Maire, Consul in Egypt, came from this place. It had been found by the Arabs of Sacara in a chamber cut in the rock and hermetically

> sealed, which by a singular chance was opened and an embalmed bull found.
>
> I found something similar in the catacombs that I have described; this bull was buried in a large case, upon which the head was represented: this case was gilded and painted, and surrounded by a beautiful balustrade around 5 feet high, also gilded and painted in various colours. There was also found in the same area eight urns of white stone, upon the covers of which are represented the heads of young girls, and upon the sides many sorts of hieroglyphs. . . .[4]

Aidan Dodson assesses Lucas's discovery:

> The large gilded and painted case that was surrounded by a five-feet high balustrade, by Lucas's account, is considered to have been made of wood by modern Egyptologists. However, there is some doubt cast on the accuracy of Lucas's work because of his presumed lack of literary skills and the fact that his book was assembled from his notes by a ghost writer.[5]

Also clouding an accurate understanding of the provenance of the site is the disappearance of Mariette's excavation journals after he entrusted them to Eugène Grébaut at the Louvre in Paris. The archaeological report of Mariette's excavations was left to Gaston Maspero, who completed it in 1880, using an incomplete manuscript left by Mariette.

With uncertainty and confusion surrounding the discovery of the Serapeum, experts on the archaeology of the site, such as Dodson, Ibrahim, and Rohl, have attempted to bring some sense of order to the history of the Serapeum, but they are working with artifacts that provide less than the best evidence for a solid, scientific theory—and they are working with hearsay accounts from ghost writers who cannot provide the accuracy of the original researcher whose methods, by today's standards, are considered crude: "When Mariette first undertook excavation work at Sakkara he was 29 years of age and without previous archaeological experience. In those days tomb clearance and analysis of finds in

situ were still crude operations, to say the least, for it was not until the 20th century that archaeology became a more exacting science."[6]

Despite the confusion, there seems to be no equivocation from Egyptologists about the purpose of the site. This was indeed the burial place of the sacred Apis Bull: Bull heads were found in niches in the tunnels, and a statue of a bull was retrieved from the tunnels and now sits in the Louvre Museum in Paris.

Because the ancient Egyptians worshipped the Apis as a god, a search was made throughout the land for a replacement of one that died or was about to be sacrificed. When an Apis died, people throughout the land mourned and practiced a self-imposed celibacy. Until another Apis was found—a bull recognized by distinct black and white markings with a saddle mark and white blaze on the forehead—there was no sex. To say that the mourners were motivated to find a bull, and in a hurry, would be an understatement. Once the animal was found, the new god incarnate was installed with celebration and joy. The continuity of the Apis god among the Egyptians was assured, signifying that the heavens were pleased and that the land and its people would be protected and flourish.

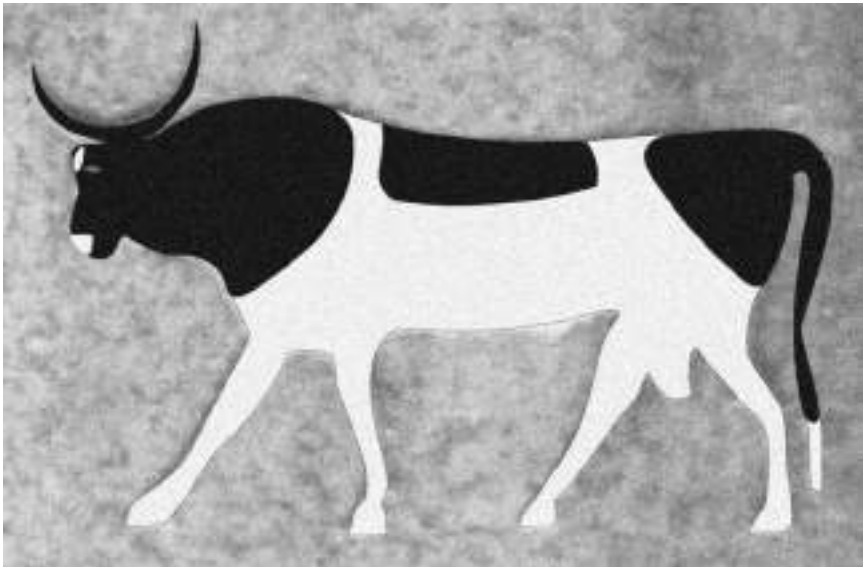


Figure 5.8. The Apis Bull

Exploring the tunnels of the Serapeum for the first time was both intriguing and frustrating. Along the dusty corridors were more than twenty-two large boxes. Each was cut from a solid block of granite, and remarkable to each was a feature that was characteristic of fourth-dynasty boxes. The inside corners have small radii (see figure 5.7), and such features are significant to engineers and craftsmen because of the added difficulty and time required to create a sharp inside corner in hard igneous rock that is made up of 55 percent silicon quartz crystal (a hardness of 7 on the Mohs scale). The technological questions it raises are straightforward—for example, what type of tool was used and why such sharp corners were needed—but after the passage of time, we can only speculate based on circumstantial evidence (the boxes themselves) and engineering sense. Reconciling these technical questions and their implications with the cultural context of the site as described by Egyptologists requires some mental gymnastics. One question in an engineer's mind: Why did the Egyptians transport 70 tons of rock five hundred miles down the Nile just to house the body of an animal? Though we must recognize that different cultures have invested significant expense in worshipping animals, there is something about this particular site that does not add up.

In one of the crypts there is a granite box with a broken corner, and this box is accessible by means of steps down to the lower floor. The outside of the box appears to be roughly finished, but the glint of a high polish on the inside surfaces beckoned me to climb inside. Running my hand along the surface of the granite reminded me of the thousands of times I have run my hand along a granite surface plate when I was working as a machinist and later as a tool and die maker. The feel of the stone was no different, though I was not sure of its flatness or accuracy. To check my impression, I placed the edge of my precision-ground parallel against the surface—and I saw that it was dead flat. There was no light showing through the interface of the steel and the stone, as there would be if the surface was concave, and the steel did not rock back and forth, as it would if the surface was convex. To put it mildly, I was astounded. I did not expect to find such exactitude, because this order

of precision is not necessary for the sarcophagus of a bull—or any other animal or human.

I slid the parallel along the surface both horizontally and vertically, and there was no deviation from a true, flat surface. The flatness was similar to precision-ground surface plates that are used in manufacturing for the verification of exactly machined parts for tools, gauges, and myriad other products that require extremely accurate surfaces and dimensions. Those familiar with such products and the relationship between gauges and surface plates know that the gauge may show that the stone is flat within the tolerance of the gauge—in this case 0.0002 inch (0.00508 millimeter) flatness. If the gauge is moved 6 inches along the stone surface, however, and the same conditions are found, it cannot be claimed with certainty that the stone is within the same tolerance over 12 inches—unless the plate has been inspected by another means and is calibrated to a known standard.

Nonetheless, moving the steel edge along the granite provided enough information for me to conclude that I needed a longer straight edge—and, preferably, even more sophisticated alignment equipment—to determine the accuracy of the inside surfaces of the box. I was also impressed to find that each corner of the box had a small radius that ran from the top of the box to the bottom, where it blended with the corner radius of the floor of the box.

Returning to the hotel that evening, my mind was consumed by what I had seen. These artifacts were meticulously crafted boxes on a very large scale. Whoever decided to make them in this way did not have a whimsical fantasy about how pretty they would be as the bulls' final resting places. It just didn't make sense to think that the ancient Egyptians would pour such resources into manufacturing coffins while the mausoleum where the god Apis rested was rough cut and undecorated, except for a jumble of stelae with no pretense to geometric balance and harmony. As for the boxes, once the lid was on top of each of them, nobody would see the perfectly flat and polished surfaces or the conformity to orthogonal precision. Visitors would see only a dusty, dark, and rough-hewn catacomb that looked more like a

London Underground tunnel than a mausoleum designed for a god.

The challenges that these boxes would present to an engineer with modern stone-working tools are significant. This was confirmed for me when I arrived back in the United States and contacted Tru-Stone Corporation, a Minnesota-based manufacturer of granite surface plates, angle plates, V-blocks, and machine bases. In 1995, I provided Eric Leither, their engineer, with the specifications for creating one of these boxes, and he responded:

> Dear Christopher,
> First I would like to thank you for providing me with all the fascinating information. Most people never get the opportunity to take part in something like this. You mentioned to me that the box was derived from one solid block of granite. A piece of granite of that size is estimated to weigh 200,000 pounds if it was Sierra White granite, which weighs approximately 175 lb. per cubic foot. If a piece of that size was available, the cost would be enormous. Just the raw piece of rock would cost somewhere in the area of $115,000.00. This price does not include cutting the block to size or any freight charges. The next obvious problem would be the transportation. There would be many special permits issued by the D.O.T. and would cost thousands of dollars. From the information that I gathered from your fax, the Egyptians moved this piece of granite nearly 500 miles. That is an incredible achievement for a society that existed hundreds of years ago.[7]

Mr. Leither goes on to say that Tru-Stone did not have the equipment to create this box and that they would have to create it in five pieces, then ship it to its destination and bolt it together on site.

After my treatment of this discovery in my earlier articles and my first book—which reflected my excitement—some readers concluded and have claimed that such work cannot be done today, but it was not my intention to mislead readers into concluding that modern engineers could not devise the means to create these artifacts today. It was my intention to portray the artifacts as incredible, out-of-place anoma-

lies that display attributes that are uncharacteristic of the capabilities of the tools available during the time period when they were allegedly produced.

In 1999, I had another opportunity to visit Egypt, and during my time there, I tried to access the Serapeum again, for this time I had brought with me a longer straight edge and a toolmaker's solid square. Try as I might, though, I was unable to gain access to the temple. I was told it was too dangerous due to water damage and that pieces of the ceiling were in danger of collapsing. I had obviously asked the wrong person for help, though the local businessman I had met at the Mövenpick Restaurant at Giza claimed that he had influence and could assist me.

In 2001 my luck changed when I was invited to be part of a documentary that Grizzly Adams Productions was making for PAX television. I arrived in Cairo at 1:00 a.m. and was helped into a taxi that was driven by a man who was quite obviously intoxicated and who, after several stops for food, water, gas, and a bathroom—all accompanied by conversations with friends—took almost two hours to arrive at a destination that would normally take less than an hour. After we arrived at the Oasis, the driver held my suitcase hostage while demanding *baksheesh* on top of the money I had paid for the taxi.

It was during this time that I met Dr. Zahi Hawass, who was at that time the director of the Giza Plateau. (Dr. Hawass has since been promoted to chairman of the Supreme Council of Antiquities.) We first met at the Cairo Hilton coffee shop, where Gail Fallen, *Grizzly Adams* field producer, introduced me to the camera crew. Dr. Hawass was charming and charismatic and listened attentively as Gail described what the video was about and what its main thrust was. Dr. Hawass was cordially dismissive of the reference to a Hall of Records, and he turned to me and asked, "What do you do?" I told him that I was an engineer and was here to pay respect to the amazing engineering feats of his ancestors. He seemed content with that answer, and the meeting concluded with arrangements for him to be interviewed the following day.

Gail Fallen had shown interest in going to the Serapeum, and after the filming was finished, we visited Dr. Hawass in his office on the Giza Plateau in hopes of receiving permission. Dr. Hawass was even more ebullient and charming than when we first met. He gave us a slip of paper with permission to see several archaeological sites: the Great Pyramid, the workers' village, and the rock tunnels of the Serapeum.

I was particularly interested in seeing the workers' village, which was a part of the Giza Plateau mapping project undertaken by the Oriental Institute in Chicago, under the direction of Dr. Mark Lehner. I was immediately struck by the difference in workmanship between the constructed walls of the village and those of the pyramids. Though the construction on the Giza Plateau was of the highest quality, with close-fitting limestone blocks, the stones built into the walls of the village were rough in shape and more like those you would find in a shepherd's dry-stone wall in the north of England than where the world's finest stonemasons once lived.

When I visited the limestone quarries near Bedford, in southern Indiana, I met a quarry worker, Tom Adams, at his home. His house, like all the other houses in the area, was built of dressed limestone that was square and regular and mortared in place to create a straight and true structure. The limestone walls of the house may not have been as precise as the Great Pyramid, but at least they reflected the stoneworking capabilities of the local industry and the skill of those who worked in the quarries and lived in the houses.

My impression was that the newly discovered settlement, the so-called workers' village, was not the home of the pyramid builders, but instead was built later out of some of the waste gathered from the plateau. Within the walls of the settlement were chunks of undressed granite, and on the plateau by Khafre's pyramid are large granite casing blocks that were stripped from the pyramid and that have quarry marks on them and pieces broken off the ends.

Dr. Hossam Abulfotouh asked Mark Lehner about this contemporaneous inconsistency when he attended one of Dr. Lehner's lectures at the American Researches Center in Cairo on December 6,

2006.[8] Engaging specialists in interpreting ancient artifacts in Egypt is absolutely necessary in establishing a credible hypothesis. Without their input, there cannot be a comprehensive understanding of the past. For instance, the pyramids on the Giza Plateau were built not by Egyptologists or archaeologists but by engineers and craftsmen. It is not surprising, therefore, that Egyptologists overlook engineering features and nuances that would be recognized immediately by those who are trained in those disciplines.

From the workers' village, our taxi driver took us to Saqqara and the office of Adel Hussein Mohamed, the director of Saqqara. With consummate Egyptian hospitality, Dr. Mohamed asked us to join him for some tea before entering the Serapeum, and we were delighted to accept. After a short time, the inspector of Saqqara joined us, and we made our way to the entrance to the rock tunnels.

Adel and Mohamed, the inspector, were both extremely good-natured men. I have found during my travels in Egypt that the Egyptian people are the most good-natured people in the world. Their sense of humor is irresistible, and they love to joke around. Walking into the Serapeum was a quite solemn affair, but when I took my flashlight out of my backpack and it fell from my fumbling hands to the ground and the batteries spilled out, the party relaxed and had a good laugh over my clumsiness.

With permission from my host, I climbed inside the box with the opening in the corner and took my gauges out of my backpack. I had with me a solid precision square that had a 14-inch (35.56-centimeter) blade. The square had been calibrated to be accurate within 0.00005 inch (0.00127 millimeter) square. I wiped the dust from the surface of the granite with a damp T-shirt, placed the square against the underside of the lid, and brought the blade in contact with the inside of the box. When I shined a flashlight behind the blade, I did not detect any gap or imprecision on either the lid or the inside surface of the box. Gail Fallen took a photograph while I held the flashlight to illuminate the square. As seen in plate 12, the granite surface was finely tooled to a mirror finish. The reflection off the surface indicates an

optical accuracy—there are no distortions or aberrations in the reflected image. Nonetheless, this does not mean that the surface was flat within nanometers or wavelengths of light—or even the tolerance of the square. What we see is a comparative test using a common gauge that has a known dimension. The results, however, do command attention and should encourage further inspection using more sophisticated metrology instruments, such as autocollimators and specialized laser alignment equipment that can provide surface mapping and orthogonal tolerances.

That an examination with more sophisticated instruments has not yet been performed does not diminish these results when we tackle the question of ancient Egyptian manufacturing sophistication. On the contrary, it dovetails with what I discovered in the temples in Upper Egypt—with the geometry and accuracy found on the Ramses statues. The difference between the statues and the boxes is that the boxes in the Serapeum are crafted with simple geometry that is easily measured, while the Ramses statues require analysis in a computer. What is found in one and reinforced in another is a clear picture of a civilization that had developed state-of-the-art craftsmanship in cutting hard igneous rock to an extremely high level of sophistication.

When compared to the geometry of a Ramses statue, the granite boxes seen in figure 5.7 (see p. 120) has relatively simple geometry consisting of flat and square surfaces. Nonetheless, the difficulty in creating this object should not be brushed aside, because upon measuring the opposite wall, I noted that it too is flat and square with the underside of the lid, which means that the vertical surfaces had to be crafted parallel to each other. Such perfection is not an accident and cannot be produced with the tools found in the archaeological record.

I next slid a precise, hardened steel, 12-inch straight edge along the surface of the granite, and I detected no deviation on a horizontal or vertical run of the instrument. Significant to me, as I drew on my own experience with precision steel on precision granite, was the perfection of the surface up to the tangency point of the corner radius. Having done such work myself and having been trained by craftsmen of old

in creating accurate right-angle surfaces by hand, my mind was full of questions. I did not check the inside vertical corner of the wall for squareness at this time, but I did use a Brown and Sharp radius gauge to inspect the corner radius where the two surfaces meet. I can testify, that when I went through my set of radius gauges in order to select the closest fit, the 5/32 inch (4 millimeter)–radius gauge fit snugly in the corner.

The inside corners of the boxes are a confounding puzzle. I wondered why craftsmen would take the time and trouble to work out the corner to a small radius of 5/32 inch (4 millimeters). In laymen's terms, a round pencil would fit very nicely in the corner. For the assumed purpose of the box, the resting place of an Apis Bull's carcass, a 24-inch radius would leave plenty of room for the bovine deity. It doesn't make sense to work out the corners to such a small dimension. Next, to make sure that the inside surface of the box was perfectly flat to the tangency point of the radius causes great consternation among technologists who are familiar with this kind of work.

The added cost of having a 5/32-inch radius as opposed to a 24-inch radius would be astronomical if the material was worked by hand. The popular belief that the ancient Egyptians had all the time in the world and could devote months or years to create this box falls flat when we consider the logic involved in creating the box this way. The squareness of the inside corner of the box in the horizontal plane was not checked at this time because of time constraints.

The conditions I witnessed among the boxes indicate a high level of technology. Though Tru-Stone did not have the capabilities to produce such an item, if a manufacturer was under contract from NASA or the Department of Defense to create one identical to those found at the Serapeum—with no expenses spared to do the job—they would certainly find a way. Yet the discussion among their engineers would go beyond what was currently available to them for tools, and they would consider tools that they would need to build specially in order for them to fulfill the contract.

The rough removal of material from the inside of the box would

not present a huge challenge, with the exception that craftsmen were working with a 55-ton block of stone. In considering the finishing of the inside of a Serapeum box, we could draw several conclusions:

1. The dimensions between the opposite walls of the box are the same at the top and at least at the bottom of the square's blade, perhaps to the bottom of the box itself.
2. The lid could not have been on the box when the inside of the box was finished, therefore:
   - The top surface of the box was likely cut flat and square to the inside surfaces.
   - The underside of the lid must have been made to the same surface flatness as the walls.
   - To arrive at this level of precision, the manufacturers would have needed metrology instruments. None have been found in the archaeological record.

Another fact we must consider is the existence of a rough box and lid in the tunnels. This indicates that the boxes were shaped roughly outside the Serapeum, more than likely before they were shipped from the quarries five hundred miles away. Certainly, having the quarrymen perform this task would have reduced the weight of the stone by about 20 tons. Interestingly, evidence in the Cairo Museum suggests that sarcophagi were shipped with the lids attached as part of a single piece of stone. Then, upon delivery, the lids were sawed off. One such box is located on the first floor of the Cairo Museum—it has part of the lid still attached to the bottom and a groove where the saw terminated.

After the lid was separated from the box proper, they were both brought into the Serapeum and were finished underground. We might ask why the work was not completed outside, in the fresh air, or why the work was not performed as the box was in transit from the quarry. We may never know the answers to these questions, but possible answers should be examined along with all the other inexplicable artifacts that do not seem to fit within the conventional view of this ancient culture.

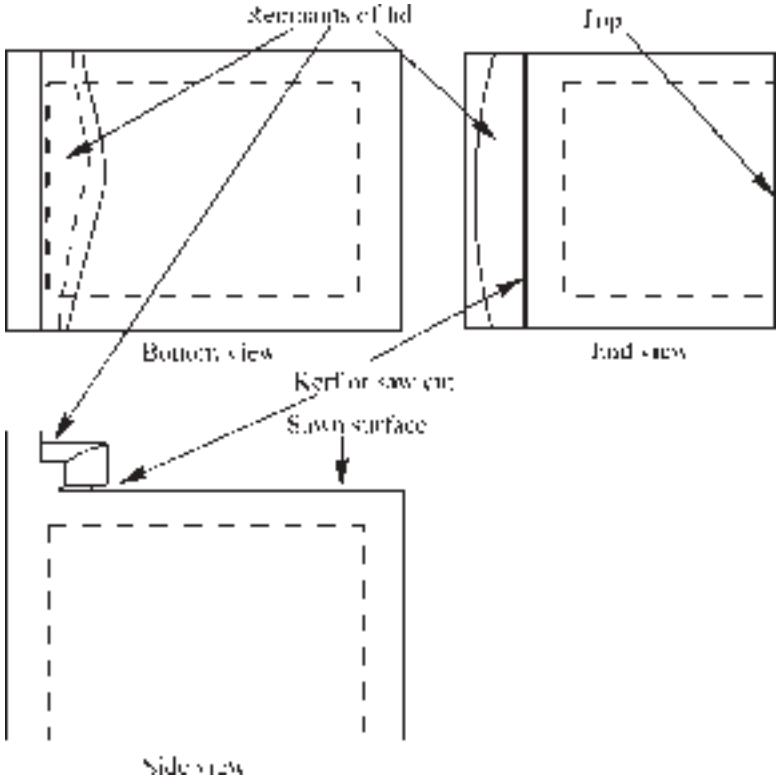


Figure 5.9. Drawing of box in Cairo Museum with remnants of a lid on the bottom

One possible answer for why the boxes were finished within the cooler confines of the tunnels may relate to the accuracy of the surfaces and the need to maintain their accuracy. If they were finished outside and then brought underground, the difference in temperatures would cause the granite to shrink in an unpredictable way, which could affect the surface flatness. This is a concern with all precision manufacturers. Surface plates may be rough machined to within 0.001 inch and then stored outside until an order is received. At that point it is brought into a controlled environment and the surface ground and lapped to specific tolerance. Also, the end users of these products need to make sure they are used in a similar controlled environment. Another reason may have something to do with proprietary processes that the artisans intended to keep hidden.

The engineering context of precision where precision is not necessary indicates the existence of sophisticated tools. These have not been found in the archaeological record, but the existence of them must be taken into account when we consider the mountain of circumstantial evidence to support their use.

In the case of the Serapeum, the list of tools and instruments that are necessary to create the granite boxes has grown. We can say with certainty that exact measuring instruments existed, for this work and the work at Luxor and Karnak could not have been accomplished without them. They are the most important and necessary tools for such work. The wooden squares, plumb bobs, and alignment instruments on display in the Luxor and Cairo Museums are incapable of giving even the most talented craftsman the information he needs to know that his work has achieved this kind of accuracy. Even if these boxes and monuments were crafted today with modern tools, such instruments are limited in what they can measure—and they most certainly cannot explain the precision and geometry that we will look at next. In the next chapter, we will examine artifacts that are similar in geometry, and others with geometry that is more complicated than a simple box, but not as complex as the head of Ramses.

It is to Giza now that we will travel, to follow in William Flinders Petrie's footsteps. Unlike this distinguished man of science, however, who studied on the Giza Plateau in his undergarments beneath a large umbrella in order to gain a wide berth from Victorian tourists, I will not be wearing pink underwear.

6
The Shadow of the Sphinx

You admire this tower of granite, weathering the hurts of so many ages. Yet a little waving hand built this huge wall, and that which builds is better than that which is built. The hand that built can topple it down much faster. Better than the hand and nimbler was the invisible thought which wrought through it; and thus ever, behind the coarse effect, is a fine cause, which being narrowly seen is itself the effect of a finer cause. Everything looks permanent until its secret is known.

Ralph Waldo Emerson, *Essay on Circles*

Using the slow strokes of ancient, ink-dipped quills to the rapidity of modern computers and every instrument in between, inspired minds have churned out hundreds of books replete with superlative prose in an attempt to explain the Giza Plateau, where the most famous Wonders of the Ancient World command the skyline. Whether seen from the shadows of the Sphinx enclosure bathed in the golden hue of sunrise, or from the shaded balcony of Hakim Awyan's home in the village of Nazlet el Samaan, or from the rooftop of Gouda Fayed's famous Sphinx Guest House as the sun sets in the west between the Great Pyramid and Khafre's pyramid, this most famous site in the world leaves the viewer with an impression of awe.

Figure 6.1. The Giza Plateau

To the uninitiated, a trip to the Giza Plateau can be a frustrating affair. When I first visited in 1986, the walk up to the plateau from the Mena House was like running the gauntlet. I had to avoid aggressive sellers from souvenir shops that lined the east side of the street and sold everything from small models of pyramids and T-shirts to replicas of Tutankhamen's mask and papyrus, and workers from nearby stables who insisted that they take you on a camel or horse ride across the plateau. In 2001, a particularly aggressive salesman wearing a *galabeya* opened the door of the taxi I was riding in and tried to get inside to sell his goods. By 2006, the area had been spruced up considerably, and the storefronts were freshly painted. A police station now occupied the souvenir shop, and its officers kept a close watch over the area, protecting visitors from aggressive sellers.

My visit in November of 2008 found a different place altogether. The road up to the plateau now has a particularly robust steel gate, and visitors are directed to a new tourist center, where they buy tickets for access to the plateau and the pyramids. Entrance to the plateau is now

through a turnstile and there are toilets available in the building where security police scan bags and give visitors a welcoming smile.

The entrance fees to archaeological sites in Egypt and elsewhere keep going up, but tourists keep flocking to see these miracles of architecture. Since my first visit to Egypt in 1986, the Egyptian people have awakened to the real value of their antiquities and are pricing them accordingly. Though it may have once cost only two dollars to explore the plateau—and that included entrance to all the pyramids—there is only one Great Pyramid in the world, and to be in its shadow now for only ten dollars is a bargain, particularly when we consider what we have paid in airfare just to get there.

There is a special energy around the Giza Plateau. Some would argue that it is due to the intrinsic design and function of the pyramids; others might dismiss this idea and claim that it is because of the holiday atmosphere of the hordes of tourists that visit the site each year. Throngs of tourists are targets for local merchants, with their hawkers spilling out onto the plateau on a daily basis to sell myriad trinkets and baubles to foreign visitors. Children dart around groups of tourists, pleading to sell hieroglyph-adorned bookmarks, small statuettes, or an Egyptian headdress known as an *egal*. Elaborately adorned pen sets and plaster cast models of famous statues of gods, goddesses, and kings are all offered for sale, and a friendly banter along with bartering is always appreciated by the sellers—but more appreciated is giving them the asking price. I have explored the plateau more than a dozen times over the past twenty-four years, yet it is one place in the world that I cannot seem to get out of my system. I find myself going back again and again for the experience of being in the presence of such magnificent achievements even as I am reminded of my own fragile existence.

The Great Pyramid has stood without question as the first and foremost Wonder of the Ancient World. Though recently an effort was made to revise the list of the Wonders of the World, the pyramids of Egypt need no vote to qualify them. Those in doubt need only perform a detailed study of their construction. No other place in the world is

blessed with such architecture and such exactness of manufacture. Even today, the precision that is found on the casing stones on the Great Pyramid is not required for construction of, for instance, a modern skyscraper. In 1883, William Flinders Petrie described the casing stones on the Great Pyramid as having an optician's precision, but on a scale of acres.[1] This is a slight exaggeration by Sir William, for the casing stones, while flat within 0.010 inch (0.254 millimeter), are certainly not optically precise. Still, the point is very well taken that the precision is not normal for stonework intended for a structure built today. The ancient Egyptians developed their tools and techniques to produce such a high order of accuracy that even the stones on the minor pyramids to the east of the Great Pyramid are cut with exacting precision and fit.

The most forceful arguments for disputing conventional views on the origins of the pyramids are thrust skyward from the desert sands as towering geometric miracles of stone. It is the engineering of the Giza Plateau that challenges historians and researchers and that has

Figure 6.2. Queen's Pyramid casing stones to the east of the Great Pyramid

attracted so many diverse views. Egyptologists admit that there is still much to learn about the pyramids of Egypt, and an air of real mystery is conveyed to the public in Egyptologists' presentations on the site. For instance, well-known Egyptologists such as Zahi Hawass, the outspoken chairman of the Supreme Council of Antiquities, and Mark Lehner, the charismatic Egyptologist with the Oriental Institute in Chicago, opened the door to the recent high level of interest in the Giza Plateau when they appeared in a 1993 documentary, *Mysteries of the Sphinx*.

Because of the tendency of engineers to focus more on engineering matters rather than on archaeology, history, or anthropology, they are often accused of stripping artifacts of their cultural context and cherry-picking the evidence. Yet as an engineer, I strongly argue that the engineering context is, in fact, a cultural context in and of itself—one that is less susceptible to ambiguity than the cultural context of mummies and potsherds, which can be added decades or even centuries after a building has been completed.

For an engineer, a visit to the Giza Plateau is a bewildering, perplexing, and thought-provoking test of education and experience. The ancient Egyptians were engineering wizards whose work never fails to impress, regardless of how many times we visit. It is also a place that, throughout its history, has fueled controversy and heated debate. At times, I have found myself at the heart of that debate because of my controversial published views on how the ancient Egyptians cut hard igneous rock. My original article "Advanced Machining in Ancient Egypt?",[2] published in 1984, tackled the ancient Egyptians' methods of cutting stone, but more recently my focus has been on the precision and geometry with which the stone was cut. This aspect of Egyptian craftsmanship does not receive the attention it deserves from academics, for if we are being honest, we would have to put aside theories about how the ancient Egyptians used bits of string or wood to create square corners and explain why granite boxes that were supposedly created with crude tools to house a mummy had inside surfaces that were flat and square to within a fraction of a human hair and had corner radii smaller than 0.25 inch (6.35 millimeters).

While I was in Egypt in 1995, I brought with me some gauges to inspect the flatness of artifacts that, when I saw them in 1986, had seized my attention by their exact appearance. Just looking at an artifact, however, is not good enough when attempting to determine its true characteristics. I needed some kind of known reference with which I could compare its exactness. I also needed something simple and transportable. The precision-ground straight edge I used in 1995 allowed me to determine a higher order of accuracy in many different artifacts than what has been described in any previous literature written on the subject. The flatness of the straight edge I used was true to within one tenth the thickness of a human hair, or 0.0002 inch (0.005 millimeter).

The granite blocks outside the pyramid were flat, but with a few exceptions, they did not have a polish and could not be considered as precise as the gauge. Yet the surface inside the sarcophagus in Khafre's pyramid (the second largest pyramid on the Giza Plateau) was remarkable in that sliding the gauge along it both vertically and horizontally was no different from sliding it along a modern granite precision surface plate that we might find in a machine shop or tool room. Discovering such precision was an unexpected surprise to me. I wondered why the craftsmen cut the inside surface of a sarcophagus to such great accuracy if its intended purpose was to be someone's burial place. Since I first wrote about this aspect of Egyptian craftsmanship, nobody has given me a satisfactory answer to this question. One argument presented to me was that the king was viewed as a god, and if the king wanted a flat polished surface, he could have one. This answer, however, raises a crucial question: How did the ancient king become aware of ultra-precise flat surfaces?

Despite all arguments against considering the ancient Egyptians to be more advanced than conventional wisdom believes, I was left wondering. While pondering this question, my mind went back to when I was serving an apprenticeship and had to create a small surface plate from cast iron. The exercise was supposed to teach apprentices how to use hand tools to create flat surfaces by filing, hand scraping, and lapping the surface till it was flat. The iron plate was first machined on a

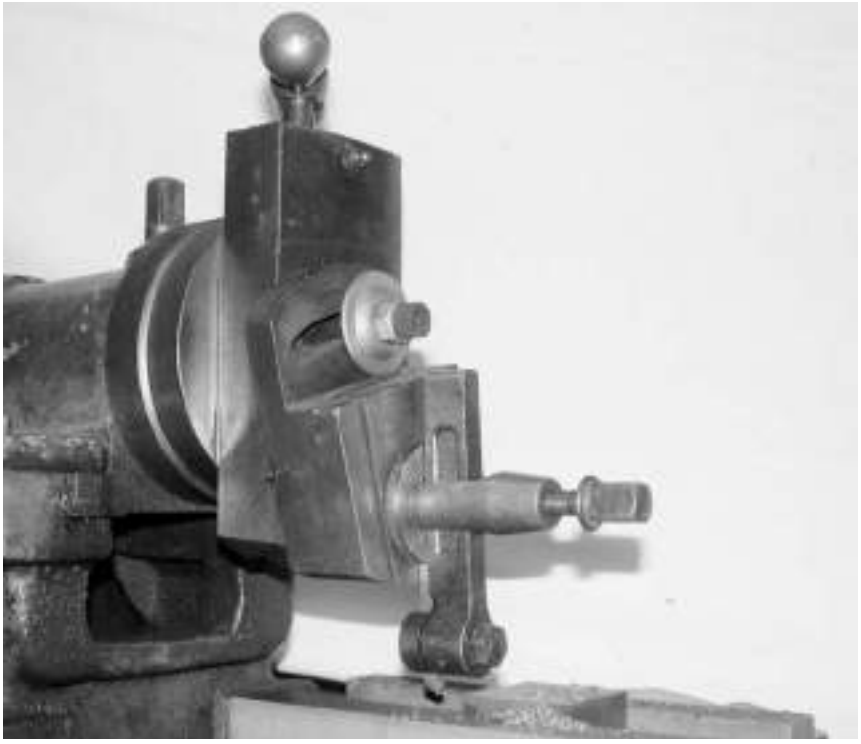


Figure 6.3. Shaper machine tool slide and clapper box. Photograph by Glenn McKechnie, September 2005.

shaping machine (a machine that is rarely seen today but was popular fifty years ago) by passing a single-point tool repeatedly over the metal to establish the basic surface.

After the plate was machined flat, we used a draw file to remove the tool marks, and then a thin layer of India blue paste was applied to the surface. A precision master straight edge (a flat iron or steel plate) was then slid across the surface in order to identify surface imperfections, or high spots. The high spots were identified where the bluing, which doesn't dry, is rubbed away on the peaks, exposing the metal. We worked down the high spots using a hand scraper, and finally, a lapping plate across the entire surface. After the plate was equally flat all over, we cut a swirl pattern (figure 6.4) into the surface using the sharp convex curved edge of the scraper (figure 6.5). This technique was used

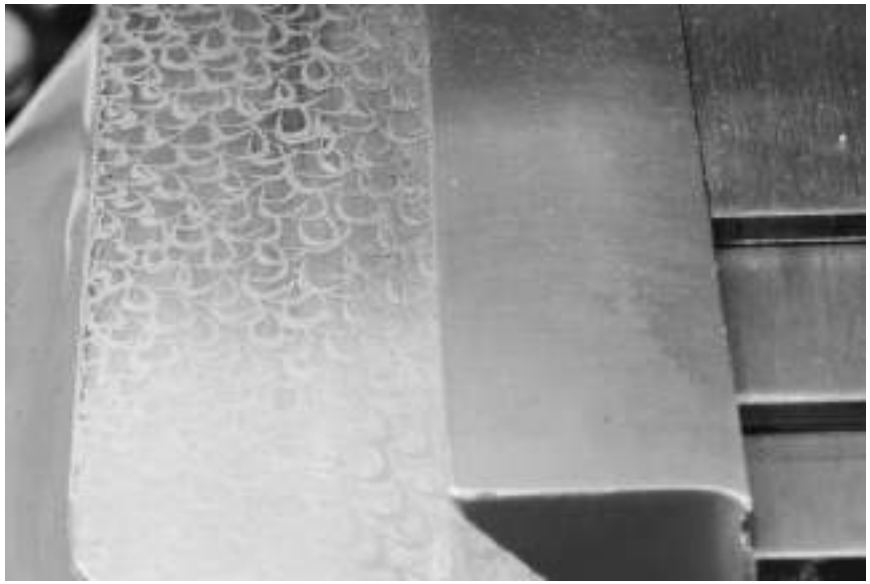


Figure 6.4. Appearance of slideway frosted for improved oil retention. Photograph by Glenn McKechnie, September 2005.

Figure 6.5. Three different engineering hand scrapers. Photograph taken by Glenn McKechnie on the 24th March 2005.

especially if the flat surface being created was a part of a machine and other components were to slide over it to retain oil in the slight depressions the scraper had made on the surface rather than have it swept away by another surface sliding against it.

A single paragraph does not begin to explain the full extent of a master scraper's craft, and certainly others may be better able to describe it. Within all trades there are particular tricks and techniques that are not obvious to an outside observer. Traditionally, these have been held close to the vest, because they were seen as job security. While helpful books have been written for an apprentice to read about his trade, his skill and understanding were gained mainly through on-the-job-training under the guidance of a journeyman or master. The life of the craftsman is echoed in the words of the famous dancer Isadora Duncan, who wrote, "What one has not experienced, one will never understand in print."[3]

When I was confronted in Khafre's pyramid, then, with an accurate stone artifact that was created in ancient times and found it similar to those that can be found in the inspection department of a modern manufacturing company, I was understandably shocked and excited. A surface plate (figure 6.6) is used in manufacturing as a baseline or datum from which a manufactured item, such as a sophisticated combustor for a jet engine, is measured. Before the Industrial Revolution, there was little need for flat surfaces that held to such high levels of accuracy, so

Figure 6.6. Black granite surface plate with jet engine assembly (Courtesy of Danville Metal Stamping Co.)

to find one that was crafted more than four thousand years in the past was remarkable.

In 1999, I was invited to speak at a conference held at the Tree of Life Bazaar in Nazlet el Samaan, near Giza. This was a time when interest in the Giza Plateau reached a fever pitch, and all sorts of intrigue and skullduggery was bandied about on the Internet. There seemed to be an excitement in the air and a belief that the turn of the century into the new millennium was going to bring new revelations and discoveries about our ancient origins—and many thought that Giza was where these discoveries would be made. In their book *Giza the Truth,* Chris Ogilvie-Herald and Ian Lawton coined the phrase "millennium fever" and attached it to principle researchers who had written an alternative view of the pyramids and other archaeological sites in Egypt.[4] The book caused some consternation among independent researchers, but it brought balance to the debate and prompted me to address some of the counter arguments in their book and to produce more and better evidence.

It was with this principle in mind that I approached both the conference and the new measurements I would be taking. I carried in my backpack a precision-ground, 12-inch straight edge: The hardened steel edge was final machined on a surface grinder, and flat on one edge to within 0.0001 inch (0.0025 millimeter). I also had a toolmaker's solid square that was similarly accurate. I knew exactly on which artifacts I wanted to use these instruments: the inside corners of the granite boxes at the Temple of the Serapeum at Saqqara and those inside the pyramids. Also in my toolkit was a set of Starrett radius gauges for inspecting the machined radius that makes the transition from one surface or contour of an artifact to another. These instruments are critical to our understanding of the basic attributes displayed by these artifacts from antiquity.

As I noted before, on this visit in 1999, I was unable to access the rock tunnel at the Serapeum—but there was certainly enough other work to do. Following my morning presentation on the advanced machining methods of the ancient Egyptians, the entire conference

group and the film crew made their way to the Giza Plateau and into the bedrock chamber of Khafre's pyramid—the one in which, in 1995, I had inspected the flatness on the inside surfaces of the black granite box (commonly known as the sarcophagus). In 1995, I exclaimed "space-age precision" to a group of Spanish tourists who were looking on as I shone my flashlight behind the precise edge of my steel parallel and noted the stunning accuracy of the black surface. This test would have shown deviation in the flatness of the surface by revealing any amount of light seeping under the straight edge—and I could detect none except in areas where indentations occurred.

Though I wrote articles that hailed this remarkable example of precision craftsmanship as additional proof of the level of technology practiced by the pyramid builders, in the back of my mind was the nagging need to go back to Egypt with additional instruments to accomplish more tests. Every time I visit Egypt, I approach these relics of the past with eager anticipation mixed with trepidation.

The cool confines of the passageway leading to the bedrock chamber of Khafre's pyramid were a welcome relief from the burning Egyptian sun. My backpack weighed heavily on my shoulders as I joined the group and made my descent. It felt familiar and right to be there at this time. I was excited to demonstrate the remarkable abilities of the ancient Egyptians that I had noted four years earlier with the eclectic group of people who attended the conference as well as to be able to document the event on film. But still there was that tinge of doubt in the back of my mind. Had I made a mistake in the past? Will the new instruments reveal anything significant?

I climbed into the granite box, which is set into the floor of the chamber, and placed my straight edge on the inside surface of the box. The edge had been prepared differently than that of the straight edge I used in 1995: it had a chamfer on both corners, which gives the user a clearer view of any light that would pass through areas that do not conform to the precision of the straight edge. Before several witnesses, I slid this edge along the smooth interior of the granite box with my flashlight shining behind it and demonstrated its absolute flatness.

While I was doing this, though, I was anxious to perform other tests. The square corners were of critical importance to me. Modern machine axes are aligned orthogonally, or exactly perpendicular, to each other to insure accuracy—and to assure that the corners a machine cuts into an object are square and true.

The requirements for producing such accuracy go beyond coincidental simplicity. I wasn't expecting the corners of the sarcophagus to be perfectly square, for perfection is extremely difficult to achieve and to find it in an ancient artifact that was supposed to serve as a coffin would be a miracle. Yet I was not prepared for what I found: I was astonished as I slid my square along the top of the parallel (I used the top of the parallel to raise the square above the corner radius) and found it fit perfectly on the adjacent surface. The significance of the find came over me, and I pointed it out to others in the group. The film crew was busy capturing it on video as I went to each corner and performed the same test. On three corners, the square sat flush against both surfaces. The fourth corner had a gap that was detected by the light test, though its variance from being a true square may have been no more than 0.002 inch (0.0254 millimeter) (see plate 13).

What does this tell us about the methods used to create this box? The implications of my previous question about why the builders found it necessary to create a coffin with perfectly flat inside surfaces had just

Figure 6.7. Using an inside micrometer to measure between corners inside a box

been raised exponentially. Why go to extreme trouble to create a box with perfectly flat inside surfaces as well as go to extraordinary lengths to make sure the inside corners are square—to within a tolerance normally expected of modern machinists and toolmakers?

In order to create a box with square corners, there has to be some way to measure them. The layperson who knows the ways of a carpenter may create square corners by measuring from corner to corner and making sure the distance is equal, but a solid granite box crafted to such exact specifications is a different class of work from that of cabinet making or squaring a structural frame.

There could be no adjusting Khafre's granite box after the insides were finished to achieve perpendicularity. The only adjustment would be to lap the entire surface again and have a means to take measurements all along. To imagine creating this without orthogonal machine axes to guide a cutting tool is to imagine a task that borders on the impossible—or at least the hugely improbable considering the box's stated purpose is a coffin.

Nonetheless, the diagonal measurement method could be used to verify what was already achieved using controlled mechanical axes, but we would need specialized equipment to do it. Before the introduction of laser metrology instruments, we might have employed two perfectly round bars in which the radius of the diameter is larger than the box's corner radii. With them touching the adjacent flat surfaces, a means of measuring between the bars would be employed. Before the introduction of laser metrology instruments, we would have used a precision inside micrometer as seen in figure 6.7.

The method shown, however, only provides information at one point in the cavity, and the box in Khafre's pyramid, as measured by Petrie, is 29.95 inches (76.073 centimeters) deep. In order to have a complete and accurate measure of the square corner down to the bottom of the box, there must be many measurements taken using this method.[5] Moreover, a precision square would still need to be employed to assure that the adjacent surfaces were square and flat with the tangency point of the corner radius.

6 OBJECTS AND METHODS.

and to put aside Western reserve, and treat them with the same familiarity to which they are accustomed between different classes. With such intercourse I have found them a cheerful, warm-hearted, and confiding people.

The list of instruments employed was as follows:—

A* Standard scale, steel 100 inches long, divided to 1 inch.
B* Steel tape 1,200 " " 50 "
C Steel chain 1,000 " " 20 "
D Pine pole, a pair 1 inch diameter 140 " " 10 "
E* Pine rods, a pair 1 × 2 inches 100 " " 1 "
F* Pine rods, 10 of ½ × 1 " 60 " " 1 "
(Jointing together into two lengths of 319 " each.)
G* Pine rods for levelling { 3 of ½ × 2 inches 60 " " 1 "
{ 2 " ½ × 1 " 60 " " 1 "
H* Pine rods, 2 " ½ × 1 in. 40 & 20 " " 1 "
J Iron on mahogany rods, 9 of 1 × 1·05 " " ½ "
K Boxwood scale, 1·25 × ·13 12 " " ⅛ "
L Steel scale, 1·07 × ·04 12 " " ⅛ "
M* Ivory scales, 2 of 1·18 × ·28 10 " " ⅛ "
N* Boxwood scale, 1·18 × ·28 10 " " ⅛ "
O* Gun metal scale, 1·16 × ·09 6 " " ⅛ "
P* Ivory scale, 1·0 × ·28 1 " " ⅛ "
(The divisions of those marked * are all known to within 1/200 inch.)
Q Double callipers, 72 inches long.
R Supports for catenary measurement by tape and chain.
S 10 thermometers for scale temperatures.
a Theodolite by Gambey { 10 inch circle, divisions 5′, vernier 5″ } telescope × 35.
{ 7 inch circle, " 10′, " 10″ }
b Theodolite by Etty { 5 inch circle, " 30′, " 1′ } telescope × 6.
{ 5 semicircle, " 30′, " 1′ }
c Theodolite by Troughton { 4 inch circle, " 30′, " 1′ } telescope × 8.
{ 4 semicircle, " 30′, " 1′ }
d Box sextant by Troughton { 6·4 inch radius, division 30, vernier 1′.
e Hand level in brass case.
f Gun metal protractor, by Troughton, 5·9 diam., divisions 30′.
g Mahogany goniometer, 11 and 9 inch limbs.
h Queen's chamber air channel goniometer.
j Sheet steel square, 35 and 25 inches in the sides.
k Folding wooden tripod stand, old pattern.
l Rigid tripod stand, 30 inches high, artabedral.
m Rigid tripod stand, 18 " "
n Rigid iron tripod, 12 " "
o 12 signals, with 3 latch bobs.

Figure 6.8. List of Petrie's measuring instruments

Petrie did not address the square corners of the boxes when he performed his measurements. However, he did perform a detailed study of the inside and the outside of the box with a range of instruments—detailed in figure 6.8—that were quite sophisticated for his time and crafted by the finest engineers.

Not only, then, do we have an artifact with flat surfaces that are similar to a modern surface plate, we have one with inside corners similar to what we would find with a toolmakers square on a surface plate with the blade touching an angle plate (see figure 6.9). With the question of the orthogonal exactness now raised, along with one hundred and twenty years of advances in technology, any engineer, including Petrie himself if he were alive, would insist that the box in Khafre's pyramid be measured again using the latest metrology instruments

Figure 6.9. A surface plate, angle plate, and a precision square

available. Petrie wrote about tolerable safe theories in his final chapter: "*. . . others may by some further discovery be shown to have been intended, but most of these will probably bear the test of time, and certainly bear the test of exact measurement.*"[6]

If we were to inspect this box today, at the very least the inside measurements of the width and lengths should be taken with inside micrometers—or, preferably, special rods equipped with dial indicators. The examination could be performed, preferably, by an Egyptian engineer or an Egyptian architect. Even a layperson could perform these checks after receiving some training, as the level of skill necessary to use these instruments is not as difficult to attain as for the instruments Petrie was using—and the result would be more reliable.

What else is significant about this so-called sarcophagus? The corners themselves! After conducting the test with the parallel and the square in May, I pulled out my radius gauges to check the corner radius and thought about a documentary I had seen in March. In the 1999 Fox special *Opening of the Lost Tomb,* a dolerite ball was shown to the audience under one of the satellite pyramids next to Khephren's pyramid and

asserted to be the means by which the ancient Egyptians created granite artifacts. This method involved bashing the granite with a round ball until the desired shape was achieved.

I'm not disputing that this is a viable means of creating a box, and, indeed, there is evidence at Memphis near Saqqara that some boxes were created in this manner (see figure 6.10). This box has large corner radii and is extremely rough and tapered toward the bottom—exactly what you would expect to produce using a stone ball.

Likewise, it would be impossible to create the corner radius of the box inside Khafre's pyramid with such a primitive method. While inspecting the inside of the granite box in Khafre's pyramid I checked the corner radius with my radius gauges. I started with a half-inch radius gauge and kept working my way down in size until I selected the correct one. The inside corner radius of the box inside Khafre's pyramid revealed a 0.09375-inch (1.009-millimeter) radius. There is, however, a rise in the material toward this radius and a cusp where another rise, presumably from the tool that cut the adjacent surface, meets the corner. The radius at the bottom, where the floor of the box met the wall, had an approximately 0.4375-inch (11.1125-millimeter) radius. Clearly, an 8-inch ball will not fit into a corner with a radius this size or even one five times larger.

So what kind of tool may have been used to cut the inside corners of these boxes? In 2001, I was able to take wax impressions of the south-

Figure 6.10. Granite box at Memphis (Photograph courtesy of Stephen Mehler)

west corner inside the box. Figure 6.11 shows that the corner reveals the geometry of the tool and may lead us to determine the method of manufacture. While other engineers may provide their own ideas to the puzzle, one possible reason for the corner profile is not uncommon in machining today. A grinding wheel may start out cutting a surface with a sharply defined radius on its edge. Through use, over time the corners become worn and the wear will appear as a taper from the edge. It appears that the cutting tool used to finish the inside of the box in Khafre's pyramid became worn, and we are left to study its profile on the inside corner of the box where the tool cut the north to south surface and then the east to west surface, leaving a cusp there the shape of the tool overlapped.

It is an incredible piece of work that speaks of a higher technology in its creation and perhaps even in its use. Even if we put aside the question of how it was manufactured, it still shouts the question: For what non-technological purpose might it be necessary to have such precision and accuracy? If we understand what it takes to perform such work, we are left with no alternative but to acknowledge a high level of technological prowess on the part of the ancient Egyptians.

Artifacts such as these fly in the face of any previous explanations

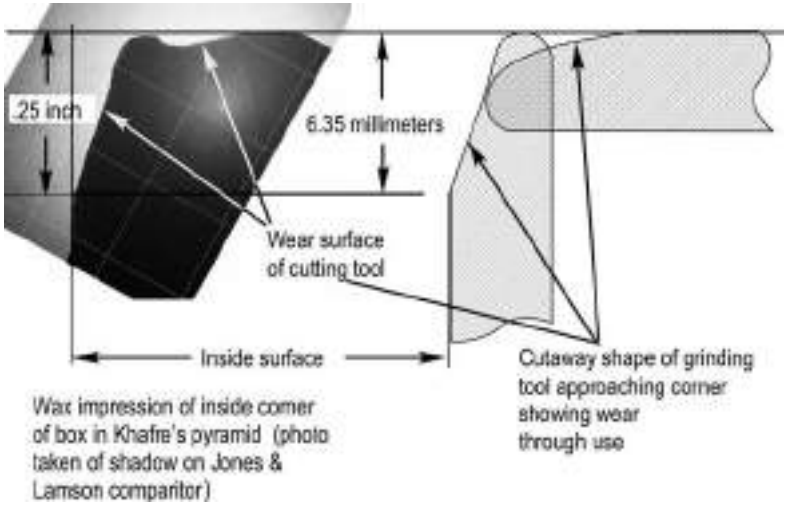


Figure 6.11. Wax impression of the inside corner

of the ancient Egyptians' stonecutting methods. Egyptologists are now abandoning their previous assertions that these marvelous granite artifacts were cut using copper chisels. Moreover, though Denys Stocks and Mark Lehner have recently demonstrated how the ancient Egyptians may have cut granite using primitive methods,[7] these demonstrations do not come close to explaining the remarkable exactness, geometry, and tool marks cut into the stones found on the Giza Plateau and at other sites in Egypt.

As we wander around the Giza Plateau, we find this precision in the most unlikely places. For instance, a single diorite block in the southeastern wall of the Valley Temple duplicates the accuracy found on the inside of Khafre's pyramid box. In the Valley Temple there are several places where the inside corners comprise blocks that wrap around to create a part of the adjacent wall. This suggests that the blocks were positioned and then the inside walls were cut to specific dimensions. The diorite block is the finest example of precision, but there are sections of the granite pillars that are similarly precise, perhaps due to

Figure 6.12. Valley Temple diorite wall block

being buried in sand and protected from wind erosion, unlike much of the rest of the granite.

Though there is now no doubt that accuracy and symmetry were part and parcel of the ancient Egyptians' manufacturing and building scheme, there is a vast difference between a simple, precise flat surface and the complex geometry of a symmetrical Egyptian statue. As viewed orthogonally along a specific axis, we have an impression of precision, but examining a three-dimensional object with a two-dimensional photograph does not provide complete information: though it looks as if the right side of Ramses' head is precisely mirrored on the left side, there are myriad points on the surface of each side that must be inspected to determine exactly how similar they are. The outline of the major features provides us with sufficient information to allow us to see just this, and we can hope this work will be performed in the future, preferably by experts in the field of metrology using 3-D photography and computer analysis.

Fortunately, I have inspected less complex surfaces that were created using the same geometric protocol of describing simple tangent circles. Yet instead of the tangent circles morphing into different shapes, as in face of Ramses or the wire frame that binds the geometry to create the surface and tool path of MadCam's head (see plate 11), these tangent circles are projected along a precise axis that can be measured.

In 1995, I inspected a block on the Giza Plateau that caught my attention because of its smooth surface and what appeared to be machined corners and a rounded surface. I presented my findings in my book *The Giza Power Plant*. As time and technology progressed, I found myself examining the block again each time I returned to Egypt. On some occasions, I invited witnesses to examine the block with me. In February 2006, I invited John Anthony West. In May 2006 I was accompanied by Judd Peck, whereas Arlan Andrews and Randy Ashton joined Judd and me in November 2008.

John West is very good at reaching the heart of an issue using simple analogies. In summarizing the evidence of precision at Giza, he said, "It's like finding a Porsche where only a wheelbarrow should be."

This is a great analogy! To discover precision normally found only on modern artifacts in artifacts from a period of time when the wheel was not supposed to have existed raises eyebrows, many questions, and an overarching sense that such accuracy was the result of a period of technological development of tools that were capable of nothing less.

In 2004, I walked with Stephen Mehler, author of *Land of Osiris* and *From Light into Darkness,* across the plateau to show him the block I had described in my book when he turned in the wrong direction. The block I had written about was about one hundred yards east of the southeast corner of Khafre's pyramid, but Stephen was heading down to the Valley Temple. As it turned out, on a previous trip to Egypt, he had looked for the block that I described in my book and had mistakenly identified another block south of the Valley Temple. Because I had not yet seen the block Stephen had found, we headed down the causeway toward the Sphinx and the block.

I was curious to see this example of ancient Egyptian stonework, and my curiosity was rewarded: it provides an excellent example of what could be described as an evolutionary step from a simple flat surface to the more complex geometries of ancient Egyptian statuary. In other words, if we consider a flat surface as the projection of a flat vertical line along a horizontal line, then the block on the south side of the Valley Temple is the projection of a profile composed of tangent radii and straight lines along a perpendicular horizontal line.

What is remarkable and important about the Valley Temple contoured block is that it shows that the ancient Egyptians crafted not only flat surfaces, but also contoured surfaces, with uncommon precision. As any engineer can tell you, a customer's specifications regarding the accuracy of their product will determine its final cost. When considering the significance of this contoured block, therefore, we must keep in mind that it was obviously an architectural element that at one time was positioned on the top of a wall—beyond the close examination of passersby. If the contour varied slightly from its path, it would not be noticed, nor would it affect the purpose it served.

There is an even greater mystery to this forgotten piece of Egyptian

Figure 6.13. Granite block outside the Valley Temple

architecture. If we discount the smaller piece nearby as originally a part of the piece we are studying, there is only one piece that has survived. If the entire wall of the temple was capped by dozens of these elements (see figure 6.14) that weigh approximately 17 tons each, where did the rest of them go? It seems that more of them would have survived if such a large number of pieces had been manufactured. A clue that provides a possible answer to this question comes from an unlikely place.

Sliding the 12-inch straight edge along the crown of the convex radius there, I could not detect any variation, which would be revealed by light showing through the straight edge's interface with the stone. At several locations around the arc I repeated the inspection with the gauge coaxial with the centerline of the radius and found remarkable consistency.

From a photograph taken of the end of the cornice, we discovered that the ancient Egyptians applied the geometry of tangent circles in building three-dimensional form (see figure 6.16, p. 159). I tried to detect a

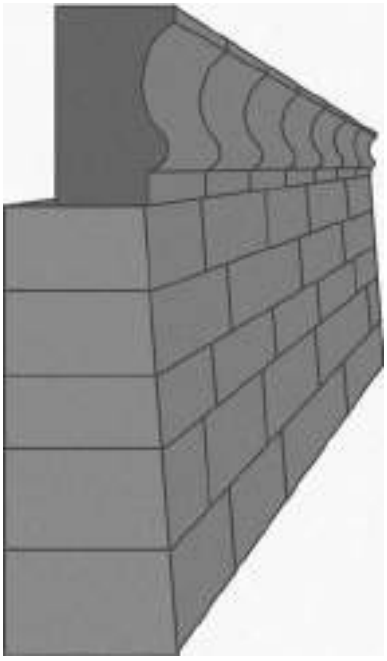


Figure 6.14. Cornice on top of Valley Temple wall

Figure 6.15. Inspecting the accuracy of the cornice

variation in the smoothness of the transition between the large concave radius and the small convex radius, but I could detect nothing but perfection of form. There are no ripples on the surface. There are no ridges or bumps or depressions. The precision and geometry of the piece cause it to stand apart from many other artifacts lying around it. It surpasses the columns and wall blocks that make up the construction of the temple, and I cannot help but wonder what important purpose it served.

Because the block was broken off at the end on an angle, the large circle (see figure 6.16) does not fit close to the end. It should also be noted, that the large circle is approximate, given the unevenness of the end. The radius at the far end, however, represents with reasonable accuracy the concave arc that begins at the bottom and ends tangent to the top convex radius. With this information, we can be reasonably certain, especially following what we have learned of the design protocol on the statues and crowns, that the piece was crafted to conform to exactness using true arcs as the design elements.

Figure 6.16. Cornice geometry

But, the question still remains: Why go to such trouble for an architectural detail that goes into a building? From a distant epoch in time, it would not be surprising to find a cornice that had been bush hammered and then given a polish without regard to a high level of precision. But to discover not only strict constraints in the design, but also the adherence to machinelike precision on a granite block that is destined merely to look elegant and attractive provides more evidence in the emerging picture of lost technology in ancient Egypt.

The answer to the mystery of how the Valley Temple cornice block may have been used may be at the place where Stephen Mehler and I were heading before he diverted my attention. I described this granite block as being similar to a couch. In 2008, while I was on the Giza Plateau with Judd Peck, Arlan Andrews, and Randy Ashton, we walked over to the block and found it being used for just that purpose by a young Egyptian woman and her boyfriend.

This piece of granite has all the hallmarks of machining. Cut into

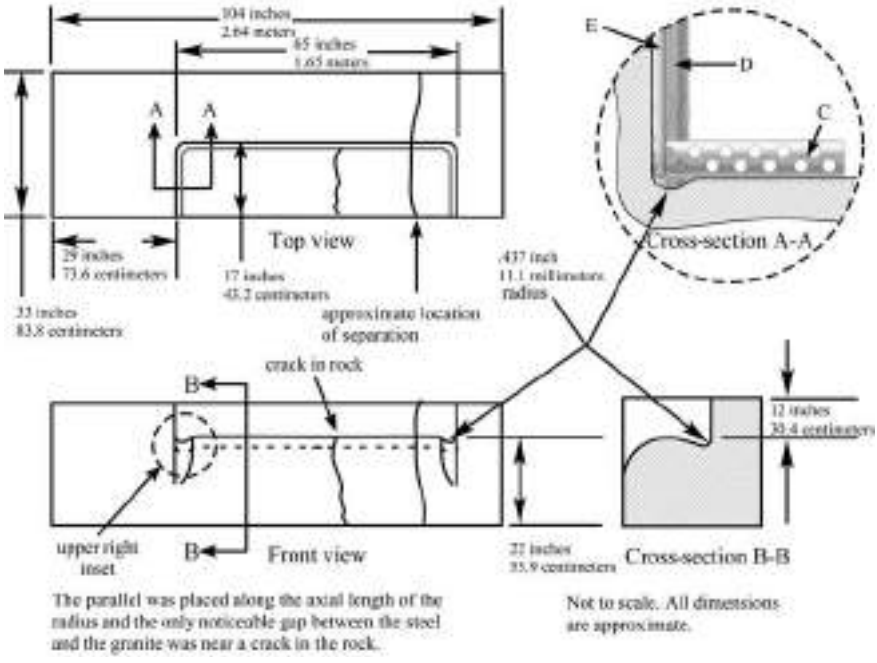


Figure 6.17. Design of Giza granite "couch"

the piece are characteristics that experienced machinists and designers use to allow a more rigid, stronger tool to be used to machine it. But, you may say, there were no machines in ancient Egypt! Why, then, would these features exist? We could say that there have been no machines found in the archaeological record that we can argue were responsible for this kind of work. This presents a bit of a conundrum, for there are no tools whatsoever in the ancient Egyptians' toolbox that can be used to replicate what has been crafted in igneous rock, and which imposes its majesty on our consciousness. But before we begin discussing what tools might have been responsible for cutting Egyptian stone in antiquity, let us take a look at what is machinelike about this block.

From a manufacturing perspective, this piece would be more difficult to manufacture than the cornice. The cornice has a simple contour that is projected along a precise path without interruption. The "couch" has three vertical walls that I call *arms* and *back* with a transitional and true 0.4375-inch (11.112-millimeter) tangent "blend" radius between the profile of the seat and the vertical arms and back that is consistent by comparative measure all around. The comparative measure was made from forming wax that was pressed into the radius and then checked in several places along the arm and back (see figure 6.18).

Figure 6.18. Checking the corner radius (Photograph courtesy of Dan Hamilton, 2004)

The seat of the "couch" comprises tangent radii that flow down to the front with no discernible variation, ripple, dips, bumps, or ridges. The quality and precision of the piece are the same as on the cornice near the Valley Temple. The only drift from perfection is a crack that runs perpendicular to the length. The radii are expressed in figure 6.19

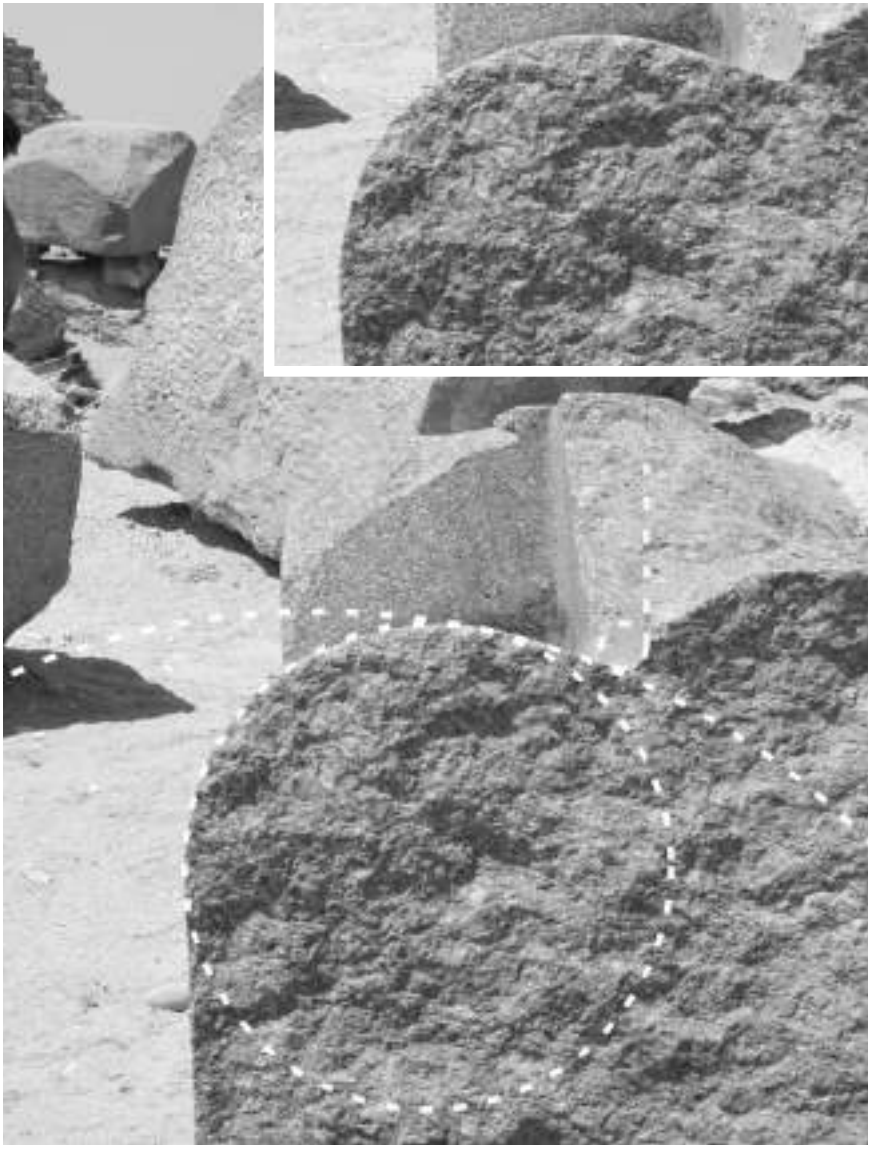


Figure 6.19. Radial components of the "couch"

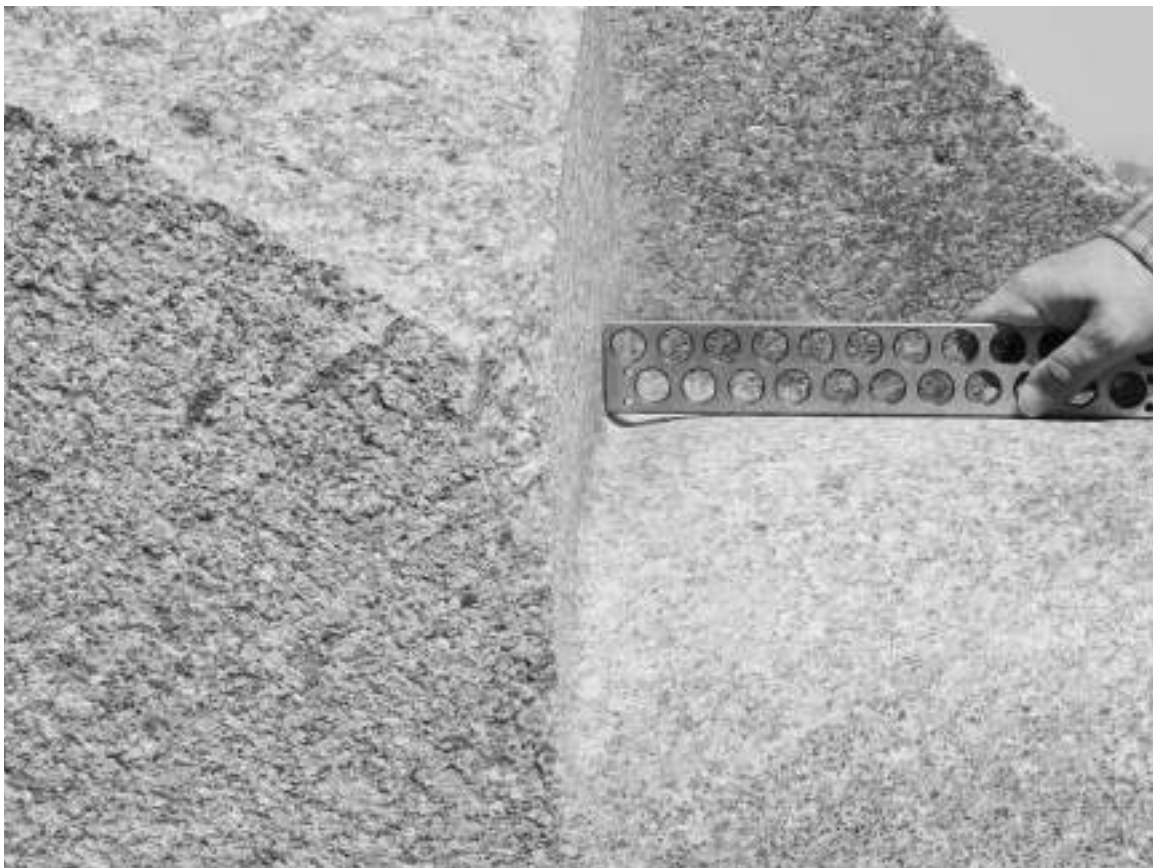
as three circles. There are slight variations in this view because of the unevenness of the broken ends. The inset shows the end view without the drafted overlay.

I inspected the seat by holding the straight edge at several locations along its length and around the contour. There was no variation in the accuracy of the contour along the length of the seat (or the radii's axes).

We can clearly see the machinist-friendly feature of the couch in the corner of figure 6.20—the radius relief in the corner. This technique is commonly used by designers who wish to have a corner that has strength and also allows for the use of a larger, instead of a weaker, tool in machining. In view A-A in figure 6.17, we see the difference. Using a tool the diameter of D instead of E along with a relief cut into the seat allows straightedge C to fit closer to the *arm*.

The contoured block on the Giza Plateau is an extraordinary piece.

Figure 6.20. Inspecting the accuracy of the seat



Because of its design, it suggests that it was made so that another component would fit against it—but I have no idea what that other component could be and what it would do. Perhaps it too, like the cornice, was merely another architectural element that had been broken out of its original place and has been lying out in the open on the plateau for millennia.

In 2006, while traversing the plateau to the east of the Great Pyramid, I came across an unusual doorway that sparked a connection in my mind to what I had written about in *The Giza Power Plant* and what I have puzzled over for years. The cornice block on the south side of the Valley Temple had diverted my attention from the block I was taking Stephen Mehler to see, but with this new evidence, a case for a connection between the Valley Temple cornice and the contoured block on the plateau started to emerge.

My focus in this book is the evidence of engineering and engineering symbolism behind ancient Egyptian artifacts. As we have seen, there is symbolism behind their design and use of sacred geometry, such as the Pythagorean triangle, the Golden Ratio, and the Fibonacci spiral. To the ancient Egyptians, doors held a special symbolism. They even went so far as to create false doors in their buildings that had all the architectural elements of a door except a functional opening. When I saw this door, then, I naturally wondered about the purpose or symbolism behind the round-shaped lintel. To include it in the design of a doorway took a great deal of extra effort—and what purpose did it serve? The doorway into the temple at Saqarra has a similar inexplicable design that elicits all manner of speculation. There, the stone is cut to resemble a series of round beams spanning the temple entrance. Throughout the Saqarra temple complex, symbolism has not taken a backseat. The complex is replete with unusual and perplexing architectural details that give us the feeling that while the Egyptians were engineering, they were thinking about the inexplicable mysteries of the universe.

These ancient doors, however, suggest a use for both the cornice and the contoured block on the Giza Plateau. In figure 6.23, we can see that the two complement each other very well. They also provide us

Figure 6.21. Doorway east of the Great Pyramid

Figure 6.22. Doorway to the Temple at Saqarra

with a reason why there are not dozens of granite cornices outside the Valley Temple. Quite simply, the Valley Temple may not have had cornices on top of its walls, but it had one in a position of prominence over an important gateway or doorway. What remains a mystery, however, is this: if the lintel and the cornice were at one time used on the same

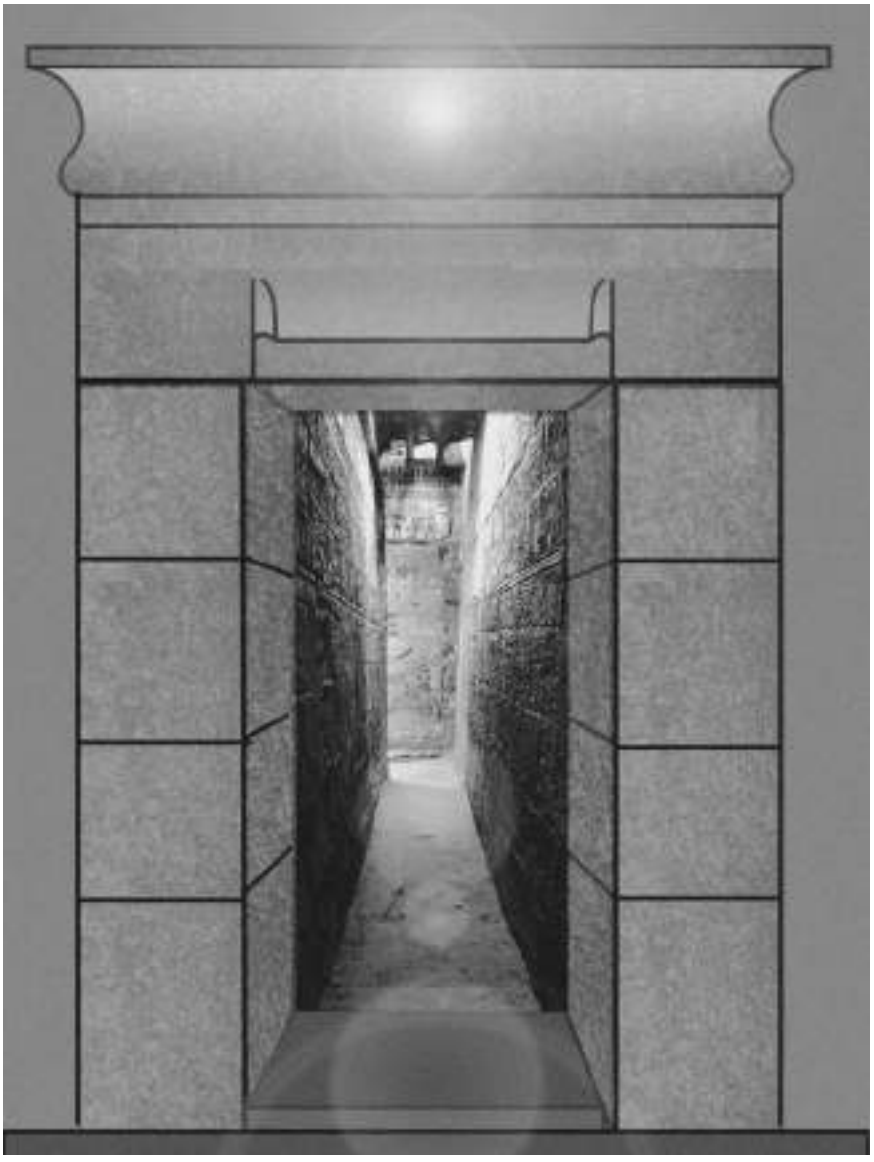


Figure 6.23. The mysteries that may lie beyond a door

doorway, how did they arrive at their current locations, several hundred yards or meters apart?

Now that we have discerned the possible architectural perfection in the doorway, we must travel through it to Upper Egypt, where the cornice is in elevated abundance and glorified by a brilliant execution of design. We must next go to Denderah, where the precision of a Rolls Royce might come to mind. Denderah is a finely crafted jewel in the desert. Though tattered and worn from the ravages of time, the Great Hypostyle Hall's rough edges recede after a few hours of study, and the consummate intelligence of Egypt's architects, engineers, and artisans comes to life.

7

The Shadows of Denderah

No man can reveal to you aught but that which already lies half asleep in the dawning of your knowledge.

Kahlil Gibran, *The Prophet* on teaching

Figure 7.1. The Temple of the goddess Hathor at Denderah

The record of precision found at the Temple of Amun Mut Khonsu in Luxor was a surprising discovery, because I did not expect to find the same level of precision that I found in and around the pyramids, which I viewed as being more mechanical than the temples in both geometric appearance and functionality. It was inspiring to learn that the temples in Upper Egypt were crafted using an application of manufacturing exactness that rivaled the pyramids—and that reinforces the importance of the temple in the ancient Egyptian culture.

Cathedrals, churches, synagogues, mosques, and temples are functional structures. Though built as a tribute to a culture's god or gods, most places of worship are constructed to reflect the highest ideals and skills that humans have reached at that time. Some may argue that in today's world, those ideals have declined, if we judge by the architecture and building materials that are used in modern buildings and compare them to those used for the monolithic and grand architecture of our ancestors. The temple in ancient Egypt was a functional construction that was probably more a part of the ancient Egyptians' life than the pyramids. It was a place for the public to interact with its gods, to experience the energies of the holy of holies, and to become rejuvenated within a structure that people knew had an important message for them on many levels. They interacted with the temple both consciously and subconsciously. Perhaps not knowing all of its mysteries, but gaining insights into a reality that was cosmic in proportion, their minds and consciousness were expanded to embrace their surroundings, as the temple embraced them.

From Luxor, Judd and I traveled to the temples of Abydos and Denderah. Because we were not a part of a tour group, we hired a taxi and became part of a convoy that left Luxor at 8:00 a.m. sharp. It was an interesting transaction. We were approached by a man near the Sheraton Hotel who gave us a card that had a nice-looking photo of a Mercedes on the front with his photograph and phone number. I asked him how much he would charge to travel to Denderah. He then showed me his car, which was a Peugot station wagon in good condition. Not a Mercedes, I thought, but okay. We hired him for

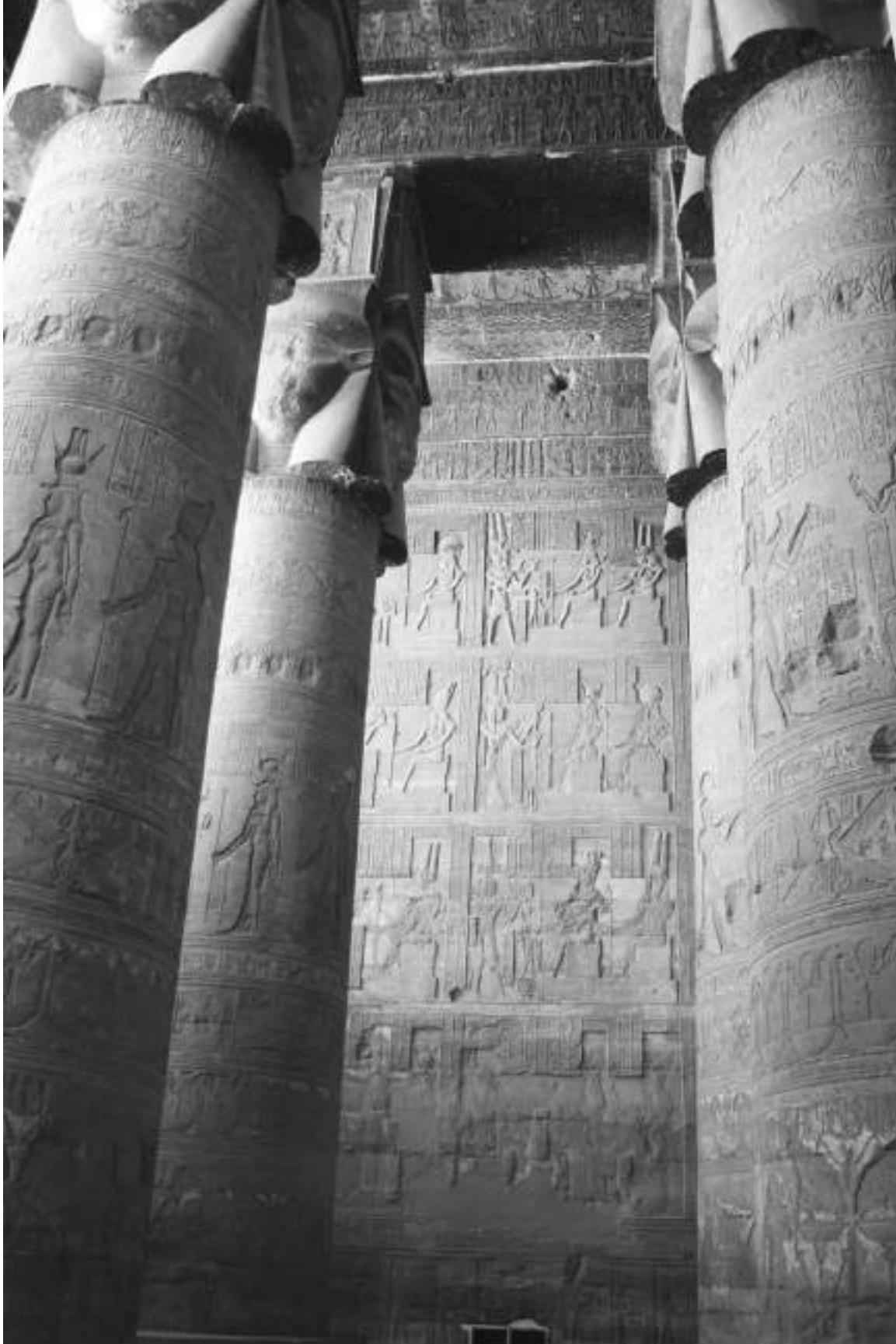
the trip. He picked us up in the morning in a beat-up older Peugeot and promptly drove to his brother's house, got him out of bed, and turned the responsibility of driving over to him. His brother, Hamde, not quite as polished and smooth as Ahmed, rushed out of his house, pulling his galabeya over his head, and drove like a madman to connect with the convoy.

In this land known for its enigma and wonder, a helter-skelter taxi ride at the tail end of a convoy of tourist buses dispels all romantic notions of the past. Twenty-first-century Egypt flies by with all the clatter and confusion of the modern world. We were heading sixty kilometers north of Luxor to the provincial city of Qena. Though security is one reason tourists are convoyed with armed policemen to these ancient temples, a more pressing concern is to move large masses of people efficiently, in accordance with a very tightly controlled schedule.

Though we visitors may sit back and feel special about the extraordinary measures that are taken to ensure that we have a fast, comfortable, and safe passage along these stretches of road, during our journey, it soon became quite clear why side roads are closed and armed guards are posted at the intersections. The taxi in which we were traveling had to stop for gas, and during the refueling period, the entire convoy passed and the side roads had opened up, spilling all manner of chaos into our path. Fortunately, a Nissan police vehicle held back for us and shepherded us through the bedlam with its siren and honking horn and with a driver whose sharp words showed no respect for man or beast. Without doubt, a journey that usually takes one to one and a half hours would have been increased exponentially under these chaotic conditions if we didn't have someone clearing our way.

Our destination was one of the most enigmatic sites in all of Egypt: the Temple of Hathor at Denderah. In ancient times it was known as the Castle of the Sistrum. It was so named after the sistrums (ancient Egyptian percussion instruments or hand-held rattles) carved

Figure 7.2 (opposite). The Great Hypostyle Hall at Denderah ►



intricately in relief on the walls and, more strikingly, those atop the faces of Hathor that form the capitals of the columns, which soar to a height of 50 feet (15.24 meters) in the Great Hypostyle Hall. The temple is also known as Per Hathor (*Per* being an ancient Egyptian word to describe "house of"), the House of Hathor, or the Domain of Hathor. Throughout Egypt's dynasties, it was said to have been a place of pilgrimage and worship, but after the ruin of the pharaonic way, Denderah was abandoned and left to the encroachment of wind-blown sand that piled high outside the temple and inside the Great Hypostyle Hall. For more than a thousand years—until the middle of the nineteenth century—Hathor's temple remained inundated by the desert.

Like other temples of the Nile, the Temple of Hathor has a long history and has been modified or rebuilt a number of times. Some of its architecture dates to the Ptolemaic and Roman period during the first century BCE. On a rear external wall relief are depicted Cleopatra and her son Ptolemy XV, Philopator Philometor Caesar, who was fathered by Julius Caesar. The Romans constructed a birth house next to the entrance, and the Coptic Christians erected a church.

During the New Kingdom (1550–1070 BCE) Thutmose III, Amenhotep III, and Ramses II and III are believed to have added to the structure. There is also an older birth house and an eleventh-dynasty chapel dedicated to King Nebhepetre Mentuhotep II, but there is reason to suspect that its original foundation dates back to a remote period of time. Inscriptions on the present structure refer to the work of earlier builders. The oldest construction activities occurred in the time of the Old Kingdom (2650–2134), during the reign of Pepi I (2321–2287) and Khufu (2589–2566).

All these additions, however, pale in comparison to the breathtaking magnificence of the temple itself. It is difficult to describe, because it was specifically designed to convey, through profound experience, incredibly important information. The eighteenth-century writer Amelia Edwards, with elevated prose, attempts to match its superlative attributes:

> The immense girth of the columns, the huge screens which connect them, the ponderous cornice jutting overhead, confuse the imagination, and in the absence of given measurements appear, perhaps, even more enormous than they are. Looking up to the architrave, we see a kind of Egyptian Panathenaic procession of carven priests and warriors, some with standards and some with musical instruments. The winged globe, depicted upon a gigantic scale in the curve of the cornice, seems to hover above the central doorway. Hieroglyphs, emblems, strange forms of kings and gods, cover every foot of wall space, frieze and pillar. Nor does this wealth of surface-sculpture tend in any way to diminish the general effect of size. It would seem, on the contrary, as if complex decoration were in this instance the natural complement to simplicity of form. Every group, every inscription, appears to be necessary and in its place; an essential part of the building it helps to adorn.[1]

In 1898, Sir William Flinders Petrie excavated a section of the cemetery behind the temple enclosure for the Egypt Exploration Fund and discovered burials dating from the fourth dynasty onward, including burial tombs, called *mastabas,* from the sixth to the eleventh dynasties. Petrie first traveled to Egypt in 1880 and returned in 1883. In the early 1890s, Petrie became interested in predynastic times and how Egypt formed its civilization, and he returned a third time in 1893. He believed that people of Punt were the progenitors of Egyptian civilization and began excavations in Coptos. Although he did not find any evidence to support his theory, he did find a large cemetery where the deceased were not mummified and were buried in the fetal position. Petrie also discovered cemeteries like this, first in Abydos and then in Denderah, the ancient capital of the sixth Nome.

On the ceiling in the Great Hypostyle Hall, ancient blue paint, with its muted brilliance, competes for attention beneath the black, sooty residue of ancient fires. The ceiling is divided into seven sections, and finely carved reliefs occupy the architraves depicting the astrological signs of the zodiac encircled by the slender form of Nut,

the goddess of the heavens. In the western architrave, along with Nut, is the god Geb, representing the earth, and the six northern signs of the Egyptian zodiac. Beneath Nut's gentle protective canopy are Aries, the Ram (Amun); Taurus, the Bull (Apis); Gemini, the Twins (two sprouting plants); Cancer, the Crab (Anubis); Leo, the Lion (Osiris); and Virgo, the Virgin (Isis). The seventh and most eastern architrave shows Nut and the remaining six signs of the zodiac: Libra, the Scales; Scorpio, the Scorpion (Sit-Typhon); Sagittarius, the Archer; Capricorn, the Goat (Mendes); Aquarius, the Water Carrier; and Pisces, the Fishes (Nephthys).

The second and sixth architraves exhibit the twelve hours of the night, and at each end a winged figure represents the wind. The third shows the sun during the twelve hours of the day as well as the moon, represented by the sacred eye. The fourth and central architrave is elaborated with winged disks and vultures (see figure 7.3). The fifth presents the twelve hours of the day, depicted as boats bearing sun disks, and the figures of the gods to whom each hour was sacred.[2]

Each interior wall is covered with similar reliefs that speak of tremendous skill and talent. Even obscure parts of the temple, such as the stairwells, are covered with marvelous decorations swelled with three-dimensional pride that leave us admiring their design and execution. The entire composition is highly ornate without appearing ostentatious. For an art lover, it could easily distract attention from the heart of its architecture—the engineering marvel that is the colonnade in the Great Hypostyle Hall. Twenty-four massive columns soar to the symbolic heavens, and each supports a capital composed of four heads of the goddess Hathor. A detailed examination of several of these capitals reveals knowledge similar to what we have examined at Luxor. Yet there is more—an accomplishment of engineering that makes even the superlative outpourings of admiration by Amelia Edwards seem inadequate.

February 2006 photographs of the temple walls and columns, after detailed analysis, prompted my return in April of that of same year with

Figure 7.3 (opposite). The winged disks and vultures ►

better camera equipment: better lenses, a right-angle viewer, and a quality tripod. I had become fascinated by the symmetrical precision of the statues at Memphis, Luxor, and Karnak—but what we see at Denderah are not necessarily statues. Though they could be considered so, they actually indicate the fusion of art and technology into a wondrous expression of engineering and confounding mystery.

Visitors to the Temple of Denderah today are greeted with a highly eroded and damaged work of art that was originally crafted and assembled with all the precision and craftsmanship we might expect from a modern manufacturer who is blessed with advanced tools for cutting, measuring, and assembly. Our senses are overcome with superlative art and architecture, but the engineering that allows Denderah to exist has key characteristics that are seldom discussed and that have not risen to the level of notice enjoyed by the pyramids in the north.

Though superlative reliefs on the walls and ceiling receive most of the attention, throughout the temple there are outstanding examples of the builders' engineering prowess. The walls, ceiling, and columns are put together with such exactness that we can only sit back in awe of such an incredible accomplishment. Though not immediately apparent to the tourist who is rushed through the temple on a tight schedule, the meticulous care with which the elements of the temple are crafted is truly astounding. The principal elements of classical architecture that we see in the Temple of Denderah have been copied all over the world. They can be found in every major public building in nearly every country on the planet.

On each of the columns themselves, above Hathor's head, a cornice sweeps outward to form a low flat crown and a base for the sistrum above, which is also topped with a cornice to meet the elements of the architraves. From Hathor's neck to where the sistrum flares out to support the architraves, a complex arrangement of surfaces combine to create features that caused me to stare in slack-jawed wonder. The uniform contours of the stylized tresses that frame each of Hathor's now ravaged faces flow into blends that, with uncompromised exactness, create the outline of her angular face. Above the forehead the cowl makes a simi-

Figure 7.4. Capital on a column in the Great Hypostyle Hall

larly precise transition into the cornice below the friezes that adorn the four sides of the sistrum.

In February 2006, I took some digital photographs within the Great Hypostyle Hall and other parts of Denderah. After I looked closely at these images in my CAD program, I applied some reference lines—and what was revealed was quite surprising. So much so that I had to return to take more photographs, but this time with my camera firmly fixed on a stable tripod and with a right-angle viewer through which I could approximate a perpendicular and orthogonal orientation.

Like the set of photographs I took at Luxor, the February 2006 photographs of the ceiling at Denderah indicated that the capitals of the columns in the Great Hypostyle Hall were crafted with machine-like precision. The uniformity of the surfaces with exact corners where a blend radius transitioned from the sweeping contour of one geometric element into the flat surface of another was evident when I zoomed in on the capitals. Unfortunately, I zoomed in digitally, rather

than optically, hence the need for my return with a mounted camera and a zoom lens. This was how I could capture relative measures of the columns and analyze them in the computer in much the same way as manufactured products are analyzed today.

Along with Judd, at Denderah I was extremely fortunate to have the help of an old temple guard named Mohammed. Traveling to Denderah behind the afternoon convoy on Sunday, we had only a short time there, but enough time to share tea and a warm conversation. We arranged to meet Mohammed on Tuesday, when he would accommodate our need for a lengthy stay at the temple, making sure we had enough time in the crypt and the Great Hypostyle Hall to set up and take photographs. It was arranged that we would travel behind the early morning convoy and leave when the last convoy was ready to travel back to Luxor in the late afternoon.

In my travels to Egypt this past decade, it has always happened that someone fortuitously came forward to offer the kind of help I needed. This was one of those moments: with sincerity and kindness, a temple guard became the epitome of Egyptian hospitality and gave us access and freedom to study and take detailed, invaluable photographs.

We had six hours to study and take photographs, but I spent much more time analyzing the results in the computer. These results present a totally different view of the temple than what we can discern with the naked eye. Visitors to the temples in Upper Egypt are greeted with structures that have been severely weathered and damaged over the millennia. The floor and bases of the columns are rough and show where repairs have been made to broken areas. The capitals of the columns have been intentionally and systematically defaced. Of the ninety-six faces of Hathor that grace the top of the columns, not one has escaped the vandalism of ancient fury.

John Anthony West—an erudite scholar who personifies Euripides' statement "the tongue is mightier than the blade"—offered an interesting perspective on the destruction of statuary in Egypt. At the Temple of Philae, he pointed out that it was almost as though the statue, or relief, in the case of Philae (figure 7.5), was being decommissioned. It

Figure 7.5. The pylon at the Temple of Philae

was not the work of vandals, because the defacement was dutifully and skillfully carried out, with carefully placed chisel marks.

The ancient Egyptians believed that statues contained the power of those they represented, and that through their noses, the statues breathed the essence of the deity—their life force. By cutting off the nose, they cut off the life breath to the statue, and it ceased to hold power over the people. My own impression at Denderah was that the destruction of Hathor's faces followed a significant catastrophic event that brought death and destruction to the Egyptians. Hathor was worshipped as the goddess of drunkenness and sex, but she was also known as the goddess of destruction who, upon the bidding of Ra, brought hardship and pain. Perhaps the survivors decommissioned or defaced the faces of Hathor because of a mind-consuming terror that she would bring more death and destruction.

Fortunately, the vandals missed a carved image of Hathor tucked away in one of the architraves. With telephoto zoom lens, I was able to pull out of the shadows a clear photograph of what the faces on the capitals might have actually looked like.

Interestingly, the face of Hathor at Denderah, is remarkably similar

Figure 7.6. The face of Hathor in the architrave at Denderah

to that of Nefertari at Luxor (plate 14), who appears as Hathor, with the horned-disk headdress. Unlike the Ramses faces that look down on visitors with a smile, Hathor at Denderah seems more interested in the drama played out on the ceiling than on the ground, while Nefertari does little to warm a traveler's heart with her hard granite, cold, haughty stare and pursed lips.

While I was setting up the camera and taking photographs, numerous tour groups rushed through the temple during the day. Some guides laced their official story of the temple with accounts of how the temple was built. The common theme, as it has long been written in Egyptology reference books on temple and pyramid building, is that the ancient Egyptians built an earthen ramp, dragged the stones up the ramp, and placed them in position. In the case of the temples, the columns were carved after all the stones were placed by working from the top down: as the masons worked their way down, the earth and ramp were removed.

As soon as the story was told, the guide yelled, *"Yala yala"* (let's go), and the group moved deeper into the temple, leaving me to ponder the contradiction before me. Through the viewfinder of my camera, I studied unusual elements of the capitals in the Great Hypostyle Hall that are significant in understanding their geometry. In order to comprehend how something has been made, we must clearly measure and understand all of its characteristics. Without knowing what it is,

we cannot state with certainty how it was made. When we analyze any part of a statue or structure, we should always identify the most difficult aspects of the work, because without being able to explain how the most difficult tasks were accomplished, the simple explanations for simple tasks—however narrow a segment of the work they comprise—do not satisfy the evidence in its entirety.

While the guide explained how the columns were put together (by dragging the blocks up earthen ramps and then chiseling them to the final shape), I pondered the manufacture and the "machined" appearance of surfaces that comprise the geometry of Hathor's capital.

Figure 7.7 identifies two features that stand out, to me, as being crafted with an uncommon order of precision, and are therefore worthy

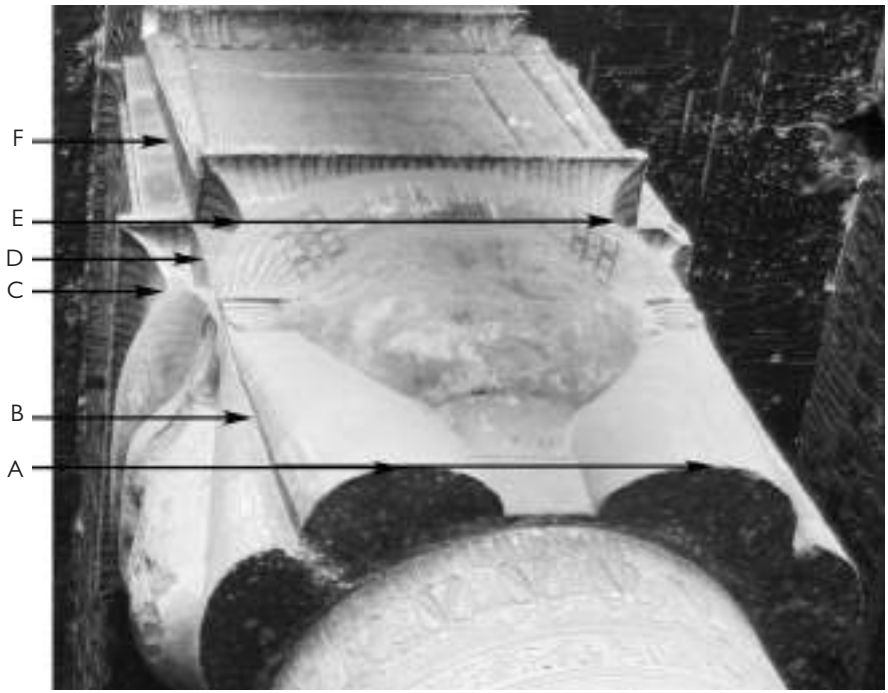


Figure 7.7. The Denderah capital. Points to remember: point A, crown point where Hathor's tresses meet the top of the column; point B, inside corner that defines the end of one face of the capital; point C, point where Hathor's cowl and the cornice meet; point D, outside corner that defines the end of one face of the capital; point E, points on both sides where Hathor's cowl and the cornice meet.

of a detailed examination. Point E, the cornice/cowl intersection, is where two adjacent cornices meet Hathor's cowled hairstyle. This point is where the radial surface, Hathor's cowl, meets two flat surfaces, the cornices on both sides of the cowl. The surfaces of the cornice appear smooth and regular, with the remains of ancient paint still evident, and the corners are sharp. Sharp outside corners are not difficult to create, but the presence of a sharp inside corner, cut on any piece, leads us to wonder what kind of tools were used to create it, especially when consistent and precise geometry seems to be associated with the sharp corner. From the base of the capital, where the tresses meet the top of the column, to the top of the sistrum, each corner transitions from an inside corner at the base to an outside corner at the cornice, and then it continues as an inside corner at the sistrum (arrows B, D, and F).

This sharp inside corner came into my viewfinder the day after I discovered another sharp corner on the headless statue of Amun with his wife Mut in the Luxor Museum. Where Amun's left buttock meets the bench both Amun and Mut are sitting on, I detected an undercut that was about 2 inches in length (50.8 millimeters). Because photography was forbidden in the museum, I had to be satisfied with merely taking a wax impression of the corner and examining it later (see plate 15).

The wax I used is hard (Kerr brand) that requires heating to 132–33°F prior to being molded against the feature to be inspected. It is commonly used in manufacturing to take impressions of small, complex internal machined features so that they can be more easily measured for conformity. The undercut on the statue is 0.078 inch (1.98 millimeters) deep, and, comparing it to a $\frac{1}{32}$-inch radius gauge, it has a 0.0355-inch (0.90-millimeter) radius. It was obviously a mistake made in contouring the statue, but it is a mistake that speaks volumes when we try to determine how the ancient Egyptians cut their statues. An ancient craftsperson would have had to invest a considerable amount of time and painstaking effort to create such a feature by hand. It could not be created suddenly by the slip of a stone or copper or bone or wood—the cutting materials cited in the archaeological record. These kinds of mistakes are not made intentionally, but are made unwittingly

and suddenly in a way that causes some anguish if the mistake cannot be accepted by the customer. On a statue, though, it is doubtful that, unless pointed out, anyone noticed the mistake.

Intriguingly, along the length of the undercut are parallel striations that follow the path of the groove. The striations range from a distinct ridge to faint lines—and, as we have learned, these are known to machinists as witness marks or ghost marks. Their presence on a surface indicates the use of a tool that leaves a consistent impression of its geometry on the surface of the material as it travels along a path, removing material as it goes. The appearance of such marks generally rules out free abrasives, which tend to create random patterns. In the case of the statue in the Luxor Museum, the witness marks inside the groove are evidence of a tool that may have been worn on the crown where two ridges appear about 0.015 inch (0.381millimeter) apart. Away from the crown, on both sides, the striations are less distinct, but they can certainly be seen as faint parallel lines.

If we consider the nature of the cut and the presumed unanticipated action of the tool that created the groove where the left buttock of Amun meets the bench, it makes sense that more advanced tools than those accepted to date were in the hands of the ancient Egyptians. Although these kinds of tools have not been found in the archaeological record of any dynasty of the ancient Egyptians, we are left with artifacts that present circumstantial evidence that they may once have existed. Also, in light of what we discussed in previous chapters, this discovery gives some hope of solving the innumerable questions and controversies associated with the crafting of ancient Egyptian stone artifacts.

From a cursory analysis of the photographs taken in February 2006, I detected a quality about the geometric arrangement on the Hathor capitals that demanded a thorough examination. With this in mind, in May I took digital photographs of the capitals, keeping in mind the necessity to capture images that were squarely aligned with the ceiling and centrally located between columns or on center with a single column. My objective was to compare the cornice/cowl intersection (points

C and E in figure 7.7) and the tresses/crown point (point A in figure 7.7) with the other elements of the capital's geometry.

The capitals are complex, three-dimensional, contoured combinations of geometric elements that have been elevated a distance of 50 feet (15.2 meters) above the floor, and the crafting and position of these elements provides significant information regarding the level of manufacturing sophistication possessed by the builders. As we can see in figure 7.8, a view looking up at a capital reveals a remarkable precision. Particularly because all points where lines intersect have three axes determining their position. In other words, a two axes view with the photograph taken perpendicular to the capital will reveal two-dimensional precision. With the photograph taken on an angle from 50 feet (15.2 meters) below, a third axis is introduced and errors can be amplified. On an *x-y-z* grid, the front view of the cornice and cowl could be considered to be the *x* and *y* axes, while the view from the side is the *z* axis.

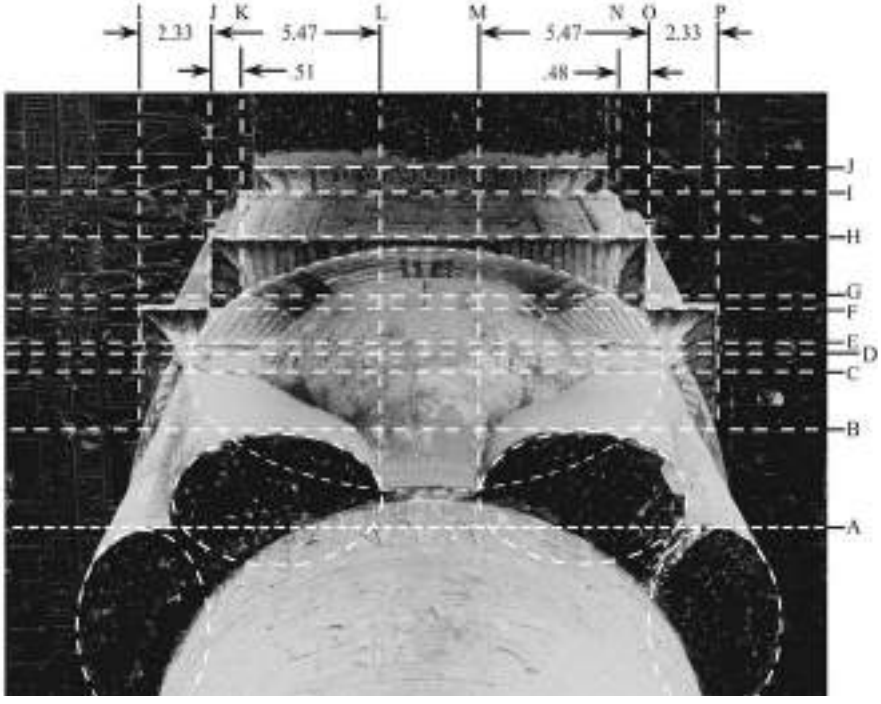


Figure 7.8. Capital geometry

For purposes of studying the alignment of the various elements, what the camera captured is sufficient to see that the flat surfaces F, H, I, and J (figure 7.8) are parallel to each other. At the cornice/cowl intersection are two points on equal sides of the center of the face where three surfaces meet. The cornice/cowl intersections are identified with lines G, K (left), and N (right). Any one of the following conditions could mean that these lines would miss the intersection point completely.

- The cornice on the front had some manufacturing variation from one side to the other.
- The cornice on the side had some manufacturing variation from one side to the other.
- The cowl was manufactured with some variation from side to side in the torus-shaped contour that sweeps down to the forehead—that is, top to bottom and side to side. (*Note:* Because of the angle of the camera, the top of the cowl does not appear in the photograph, and what is seen is the surface of the cowl's contour. This is a significant observation that makes the exactness more remarkable.)

While we are only studying one face of the capital, there are indications that this exactness was crafted on the other three sides as well. Remarkably, line D crosses the cornice/cowl intersections of both the right and the left side of the capital. It is interesting to note, also, that Hathor's ears, commonly seen to resemble those of a cow, come into play when line D crosses the top rib on the inside of the ear on both sides. Moreover, these features of the capital that consist of cleverly crafted three-dimensional contours find a correspondence on their tops and bottoms with line C and line E.

The dimensions applied are relational; they lack a system of measure and are not intended to provide dimensional data. They were measured in my CAD program after the vertical lines were applied and have no bearing on absolute accuracy because of the scale in which they were drawn. Further studies would need to be made to quantify the amount

of any variance to geometric perfection that Hathor's capital may possess. Nonetheless, geometric perfection cannot be claimed when we see line B crossing the crown points of Hathor's tresses. Not to disrespect the craftsperson who created this sculpture, because we recognize his or her appreciation for the ellipse—on Hathor's cowl and where the tresses end at the top of the column—even if he or she did leave a high spot, revealed by the ellipse, on the right (Hathor's left). The question before us would be, therefore, is this error contained in the y or z axis? That will remain a mystery until further studies can be performed.

The adjacent faces at right angles to our view of figure 7.8 provide us with a tantalizing view of what we might find when the Hathor capitals are completely analyzed. Not only do the cornice/cowl intersections line up, but also, as seen with line A, the bottom of their tresses where the inside corner is cut, seen more clearly in figure 7.7, share the same horizontal plane. And here, again, we see the prolific use of ellipses in the design scheme.

When we view the capitals of Hathor from the ground with the naked eye, we fail to see the methods used to craft and assemble them. Close-up photographs, however, reveal that they were made out of more than one block and skillfully and exactly assembled with joints that are hardly detectable.

The design of the capital shown in figure 7.9 is typical of all those I examined. Figure 7.10 prompts some intriguing speculation about their manufacture. Were they crafted before being assembled, or were the blocks stacked up, in the manner suggested by Egyptologists, and then crafted in situ? It would seem that for purposes of quality control, a scheme whereby the stones are cut before being assembled would allow for greater precision, for it is quite obvious from the photographs that the split lines between the blocks necessitated exact surfaces in order for them to fit without a gap between them. In terms of difficulty, it would be hard to argue for one method over another. Either way, there are huge hurdles to overcome in replicating this ancient miracle. This fact becomes more relevant when we expand our analysis to that of the columns' relationships to each other.

Figure 7.9. Assembling Hathor capitals

In studying figure 7.9 and figure 7.10, it appears that the enormously difficult task of creating the inside sharp corners may have been overcome by making the cornice separately before assembly. There is a faint hint of a joint where the cornice meets Hathor's cowl in figure 7.10 and, while difficult to state assertively at this juncture, where the back of the cornice meets the flat surface where Hathor's cowl ends, the corner is so sharp that it would be reasonable to suggest that the entire cornice was made separately before it was assembled in the capital.

This would raise other problems of manufacture. There would need to be a near-perfect geometric design that was applied to both the cornice and the cowl. It is not surprising to find, therefore, the ancient

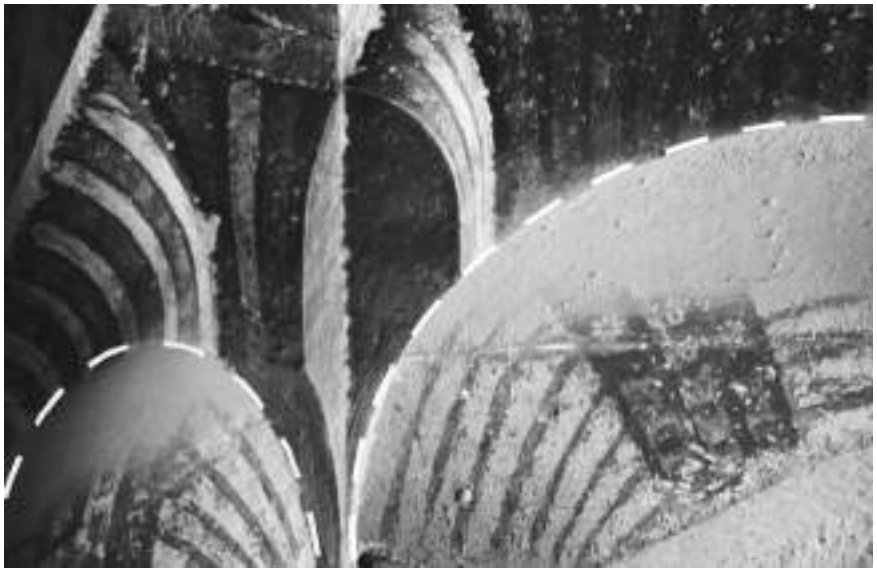


Figure 7.10. Hathor's capital assembly

Egyptians use of an ellipse as seen in figure 7.9 and sections of ellipses in figure 7.10.

However, I am not sure if Hathor's cowl is truly an ellipse. A circle viewed on an angle will appear as an ellipse. Similarly, an ellipse viewed on an angle may appear to be an ellipse with a different aspect ratio, or even a circle. Perhaps in the fullness of time answers to these puzzling questions will come. What we leave the capital with, though, is an understanding of the possible engineering and manufacturing that had to have been expended to bring Hathor to life in the Great Hypostyle Hall at Denderah.

Considering the columns' height, examining one capital to determine its geometry and precision reveals a quality of work that is surprisingly accurate for an architectural element constructed more than three thousand years ago. After seeing the Ramses sculptures at Luxor, however, should we be surprised? At Luxor, though, we were examining statues, and not the placement of architectural elements inside a building. The real test of a builder's skill is not just the crafting of a precise column, but the placement of that column in relationship to other columns.

Plate 16 is a photograph taken at the center of four columns. The image was aligned with horizontal and vertical lines drawn in the CAD program, and the lines were positioned over key features. The straight and flat surfaces have green lines, the inner cornice/cowl intersections have red lines, and the outer cornice/cowl intersections have blue lines. Also drawn were green lines touching the V-shaped grooves that were cut along the length of the tresses and which distinguished one side from the other. The bottoms of the tresses approximate ellipses to a degree of accuracy that eliminates chance and that reinforces the geometry seen at Luxor and Karnak in the White Crowns. In plate 16, four magnified insets of the cornice/cowl intersection give a better view of the location of the intersection in relationship to the crossed lines.

I have some experience on a smaller scale with assembling to exacting specifications precisely crafted objects with unusual geometries, thus what my camera revealed in plate 16 gave me a new level of respect for the ancient Egyptians' manufacturing and assembly abilities. To understand the significance of what this arrangement of four columns represents, we can study figure 7.11 on page 190.

The cornice/cowl intersection is a point in three-dimensional space that is created where three surfaces come together. In order for the condition seen in plate 16 to exist, the ancient Egyptians crafted identical capitals with precision, and then, maintaining similar precision, they mounted them on top of each column—the surface of which was perfectly flat and of the same elevation—with minuscule variation, column to column.

The point where the cornice and cowl meet, have to be accurately manufactured to dimension A and dimension B, as seen in figure 7.11 on page 190. The cornice/cowl intersection points provide the most powerful evidence with respect to a possible method. Seen from below, these points are barely noticeable, and I doubt whether anyone would give it any attention if it varied one side to the other or if one capital was rotated so as to throw off the alignment slightly. It is quite possible that those who crafted the columns were not interested in this point, but that their tools were such that precision was copied from capital to

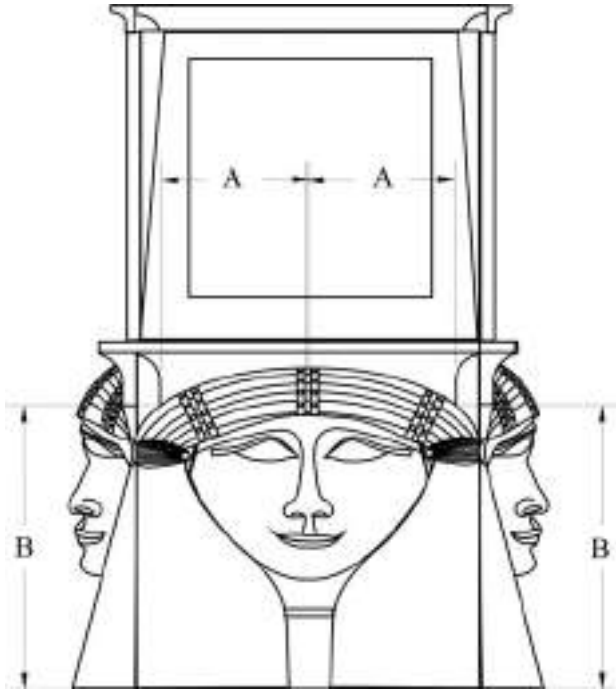


Figure 7.11. The capital's necessary precision

capital, replicating the same geometry each time. It is astounding that even with precision crafted into the capitals and each one lined up for installation that the builders were able to position them with such accuracy. This surely has to be one of the most incredible accomplishments of the ancient Egyptians.

Taking the study one step further, I analyzed six columns and illustrate their alignment in plate 17. Again, red and blue lines cross their own color at the cornice/cowl intersection, connecting each capital and column with orthogonal perfection.

Before we move away from the columns in the Great Hypostyle Hall, there is another feature associated with Hathor to which we should pay closer attention. Statues of Hathor usually depict her with bovine ears. Hathor was often depicted as a full cow with the sun disk between her horns or as a slender woman wearing horns and a sun disk headdress. Hathor in the Great Hypostyle Hall at Denderah is seen with cow ears,

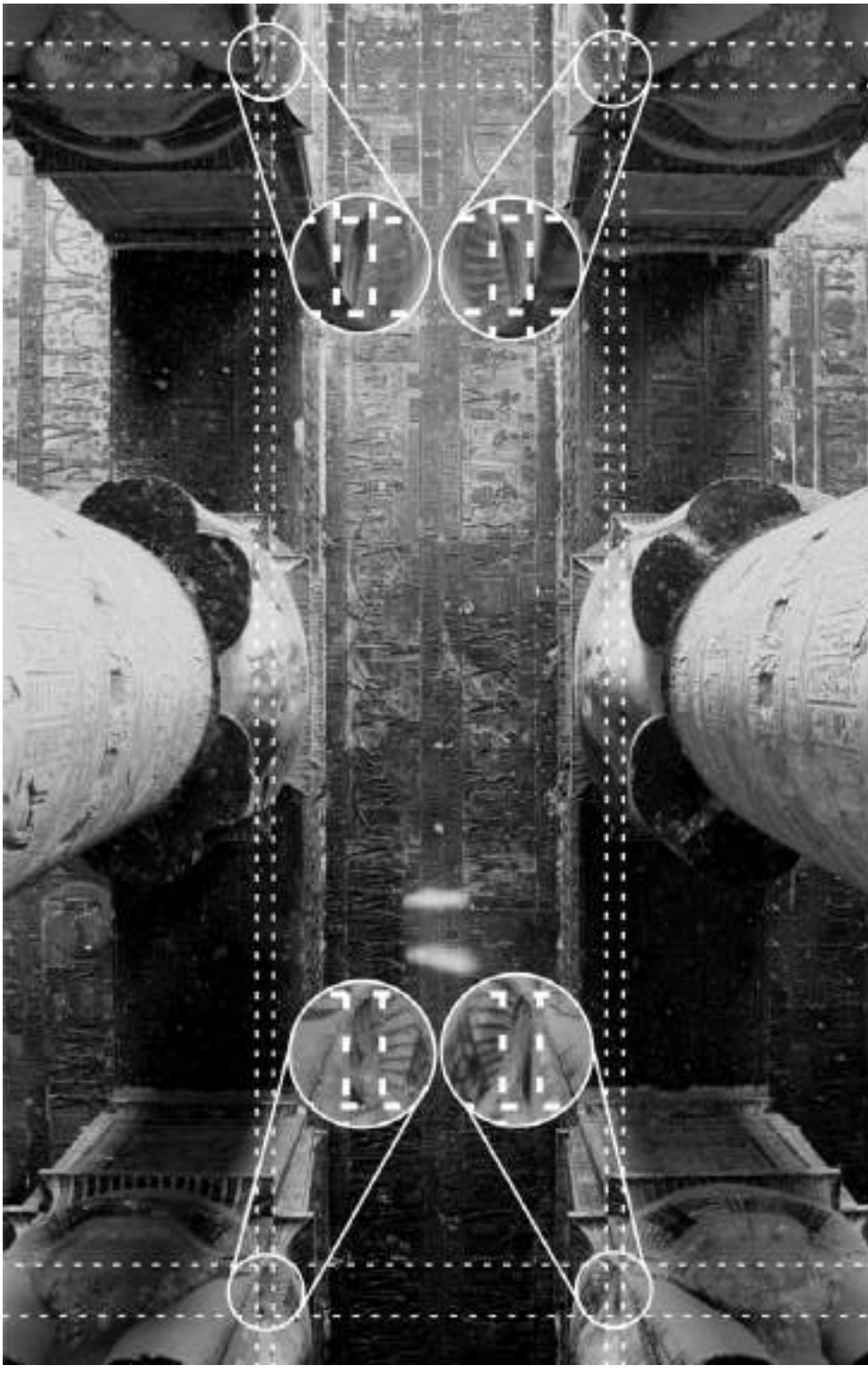


Figure 7.12. Hathor's ears

and it is the location of the ears that gives us some indication of the geometric replication of the capitals.

At first glance, the ears do not seem to be part of an exact geometric design. Looking at an ear, what we see is a feature that looks as though it was scooped out of the rock with a chisel. Figure 7.12, however, seems to tell us something different: these features were not the result of a sculptor's chisel, which might have been concerned with only one ear at a time, or even a team of sculptors who were each working on a separate ear.

From a distance that exceeds 20 feet, the ears on the outer capitals are in alignment with each other. These are three-dimensional contoured features, not flat surfaces with a simple radius that are crafted into other three-dimensional surfaces. Figure 7.12 speaks to the accuracy of the cowl into which the ears are cut and the replication of the ear geometry.

I have spent a considerable amount of time trying to come to terms with how the temple was assembled. As I think of this structure in the comfort of my study, it appears in my mind as a highly complex assembly of precision parts. Even the reliefs on the architraves appear to conform to a particular pattern. Though there are variations between the anthropomorphic reliefs depicted in figure 7.13, their overall shape and dimension is remarkably similar.

These images are just a small example of the vast array of images that cover every square inch of the inside of the temple. There seems to be strong evidence to support the view that the walls were carved after the blocks were placed. The ceiling, however, seems to be a different matter. Each of the ceiling blocks is perfectly fitted against the others. Even after millennia, the blocks do not show signs of drifting apart.

It would seem that to cut the reliefs on the ceiling would be much more easily accomplished on the ground than after the blocks were put in place. If this was done, however, it would have been an incredible accomplishment to match the reliefs from one block to another, and such perfection would certainly support more the point of view that the carvings were made after the blocks were put in place. Yet there are two blocks in the ceiling that seem to support the idea of the ceiling blocks

being installed fully finished: Intricate carving and precise surfaces were ready to meet another ceiling block. Perhaps the blocks were finished along the joint surfaces, and then, with the ceiling surface turned up, the reliefs were applied. Yet even this scenario does not quite explain a very subtle but significant difference in the way the shape of a dog's legs flows from one ceiling block to the other.

It appears in figure 7.14 that the carving of Anubis on the left was performed while the blocks were separate. The clear demarcation of the split line interrupts the natural form of the left leg, as seen in Anubis on the right, and there is a clear discontinuity along the neck.

While visiting the temple in November 2008, I had a further discussion with Arlan Andrews about the possibility that the Temple of

Figure 7.13. Two reliefs of the goddess Sekhmet on the architraves

Denderah was carved before being assembled. The topic came up when he was pondering how the reliefs were carved on the walls in the stairways to the roof. These stairways are very narrow, and the walls on both sides are intricately carved with reliefs. The blocks that comprise the walls are fitted with an exactness similar to that found on the casing stones of the Great Pyramid. As figure 7.15 illustrates, the joint is noticeable only because of the leaching of salts between the surfaces. This is common throughout the entire temple and is the only reason we are able to see the finely fitted joints on the capitals in the Great Hypostyle Hall.

Dr. Andrews suggested that the wall's stones must have been carved before being placed because of the enormous constraints that the artisans would have been faced with in this dark cramped space. Considering the evidence found on the ceiling, the idea makes sense. It also adds to the picture that is already taking shape of a culture that was using methods that we have so far not clearly identified.

Considering the level of perfection that is seen in the rest of the ceiling blocks and walls, if indeed they were carved before being put into place, the Egyptians accomplished an amazing feat of craftsmanship and engineering. Regardless of which side you come out on in the argument, along with all the other wonders at Denderah, it should surely elevate this temple to the status of Wonder of the Ancient World.

Figure 7.14. Figures of Anubis carved in the ceiling blocks

Figure 7.15. The stairway at Denderah

While driving back to Luxor on Sunday in May 2006, Judd and I were treated to a sight similar to the one Amelia Edwards described on her journey up the Nile to visit the holy man Sheik Selîm:

> "Do you see Sheik Selîm?" cries Talhamy breathlessly, rushing up from below. "There he is! Look at him! That is Sheik Selîm!"
>
> And so we find out that it is not a monkey but a man—and not only a man, but a saint. Holiest of the holy, dirtiest of the dirty, white-pated, white-bearded, withered, bent, and knotted up, is the renowned Sheik Selîm—he who, naked and unwashed, has sat on that same spot every day through summer heat and winter cold for the last fifty years; never providing himself with food or water; never even lifting his hand to his mouth; depending on charity not only for his food but for his feeding! He is not nice to look at, even by this dim light, and at this distance; but the sailors think him quite beautiful, and call aloud to him for his blessing as we go by.[3]

Today, our Sheik Selîm was not a stationary broken-down man, but a gentleman of stature with a determined stride and an equally determined nakedness. He was walking down the middle of the road with the indifference and gait of a camel: a haughty stare toward his destination with no mind for yapping dogs or playful children. While tourists—other than myself and my distinguished fellow traveler, of course—gawked, the local inhabitants paid little attention. It is customary in Egypt to give "unusual" characters a wide berth, which is why William Flinders Petrie performed his triangulations on the Giza Plateau dressed only in pink underwear and positioned under a large umbrella. To the Victorian tourist of his day, the sight was enough for them to give *him* a wide berth.

The world has changed drastically since the time of the building of the temple of Denderah, both in attitudes and technology. The methods the Egyptians used described in textbooks and academic journals, however, have changed little since Petrie's day. In the next chapter I discuss these methods to see if there has been any progress regarding recognizing the ancient Egyptians' true capabilities. Has it progressed over the past one hundred thirty year period since Petrie became the father of British Egyptology?

8

Sticks and Stones: Tools of the Trade

Quarrymen of the Pyramid age would have accused Greek historian Strabo of understatement as they hacked at the stubborn granite of Aswan. Their axes and chisels were made of copper hardened by hammering.

Dr. I. E. S. Edwards, Egyptologist[1]

When Sir William Flinders Petrie presented his discoveries to the Royal Society in London, if he had been asked about a hard drive, he probably would have mentioned the London-to-Brighton run, which was to take place for the first time on Saturday, November 14, 1896. At the start of this memorable drive, a red flag was symbolically destroyed as the speed limit was increased from four miles per hour to fourteen miles per hour, which made redundant the man who was required to walk in front of a motor vehicle holding a red flag as a warning to pedestrians. Petrie was born in 1853 as the second Industrial Revolution began to pick up steam. Trains, ships, and factories increased their pace. Computers were not even a dream at the time, and the first working, efficient internal combustion engine was one year away from being patented in 1854 by the Italians Eugenio Barsanti and Felice Matteucci.

Since that era, creativity and invention has propelled us through

Figure 8.1. The Cairo Museum

time to the present, when electrons move letters faster than the post office ever thought possible and pink underwear on the Giza Plateau, such as the kind Petrie wore to keep away tourists, may not be considered as unusual as it used to be. In the one hundred thirty years since Petrie published his seminal studies of the pyramids and temples of Egypt, the hand tools and building and sculpting tools used by men and women have improved exponentially in capability and efficiency and hard drives are better known as integral devices in a computer.

Yet we are taught that during the three thousand years that the ancient Egyptians flourished on this planet, the tools used by men and women did not change. How could this be? The finely crafted and precise boxes inside the pyramids at Giza were supposedly created in the fourth dynasty, 2500 BCE, or forty-five hundred years ago. The

finely crafted and precise boxes inside the rock tunnels of the Serapeum were supposedly created in the eighteenth dynasty, 1550–1200 BCE, or thirty-five hundred years ago. We are asked to believe that in a one-thousand-year span, the ancient Egyptians did not make any significant improvement in their tools and methods for cutting hard igneous rock. We, however, have examined the results of their labor, and it is clear that the Egyptians were not stupid people. In fact, they were geniuses in their accomplishments, yet we are to accept that while they tapped into the awesome power of the human spirit and creativity, they did not ask, over the course of a full millennium, how they could do their job better—how they could demand less pain and strain from their workforce, how they could do more with less effort, how they could reduce injuries and provide workers with more time off. If there is any mystery to ancient Egypt, it is why a paradigm that was established one hundred thirty years ago still holds force among many Egyptologists and archaeologists.

The ancient Egyptian toolbox, we are told, contained simple tools made of materials that can be found in nature without further development or processing. These tools can be found in the Cairo Museum and the Luxor Museum as well as lying around the quarry at Aswan:

- Wooden squares
- Wooden plumb bobs
- Wooden bows for bow drills
- Wooden sledges, or sleds, for hauling
- Wooden pry bars for levering heavy weights
- Wooden handles for axes
- Wooden hammers or mallets

- Copper chisels
- Copper saws
- Copper tubular drills
- Copper adzes

- Stone dolerite pounders or hammers
- Stone chisels
- Stone axes

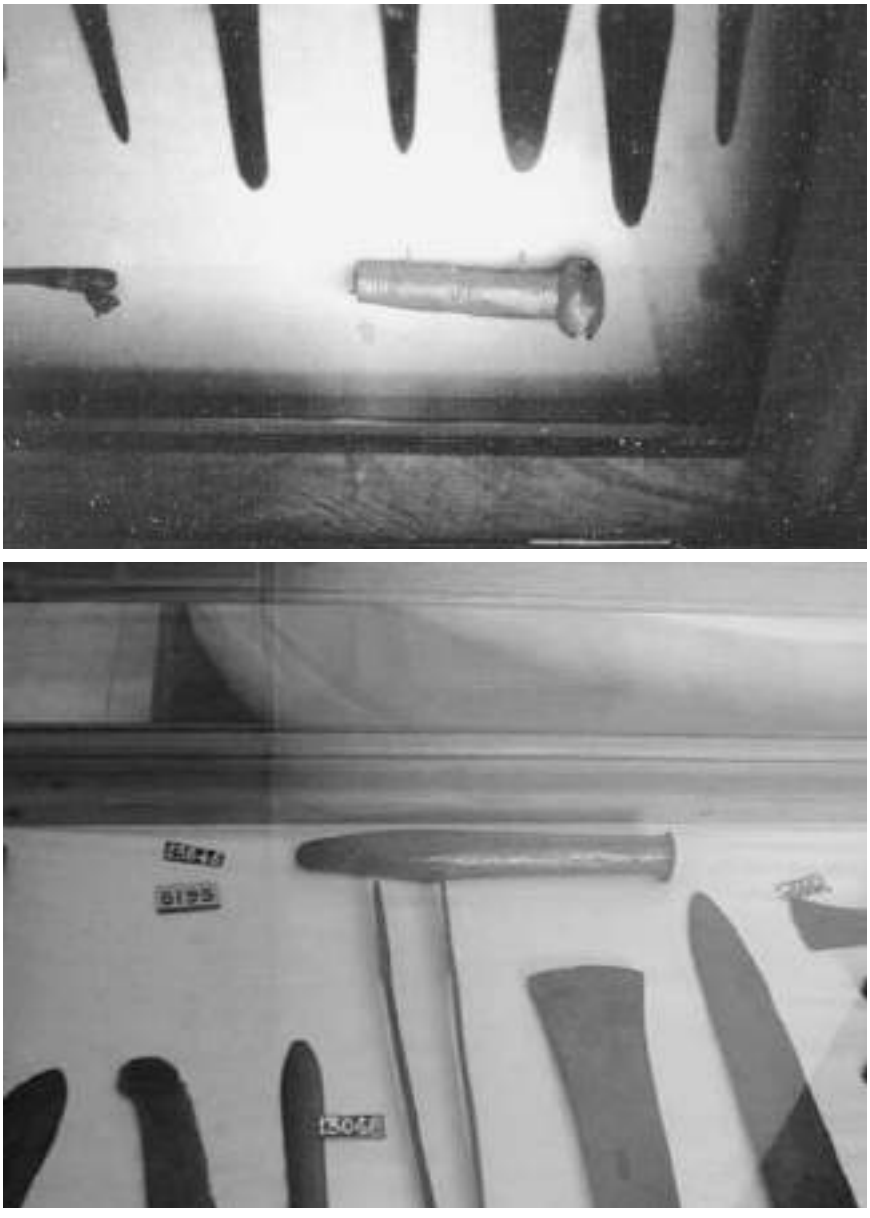


Figure 8.2. Tool case in the Cairo Museum

In 1986, when I visited the Cairo Museum, I asked a friendly Egyptologist guide how the pyramids were built. He led me to two cases where a collection of copper implements were housed. In it were several copper chisels and other assorted implements. After having spent three days exploring the plateau and going through each of the pyramids more than once, I stared at the case in disbelief. How could these paltry primitive tools be responsible for such an engineering accomplishment? It just didn't seem possible, especially after seeing the enormous amount of granite used in the construction. Yet here a respected Egyptologist insisted that it was so. It turns out that nothing has persuaded Egyptologists to think otherwise in the two decades since that time.

I asked the guide how it was possible that a soft metal such as copper could cut hard stone—particularly granite. His answer was to guide me to a travel agent through whom I could buy plane tickets to Aswan, where, he said, I could see how the granite was quarried. He explained that slots were cut into the granite, and then wood was inserted into the slots and soaked with water. After the wood swelled, the hydraulic pressure caused the granite to split. It was then dragged out of the quarry on sleds and transported down the Nile River on barges to Cairo and subsequently to the pyramids, where it was fitted into place.

The guide gave me the official understanding of Egyptologists, who have surveyed the accomplishments of the ancient Egyptians and considered what scholars found in the archaeological record, and thereby concluded that they possessed all they needed to explain everything. There was no mystery. Everything was available to explain how all the artifacts from that period were crafted. The chisels in the cases were there, so obviously they played a part. At the Aswan quarries there were dolerite balls lying around—so they obviously played a part—and tombs were found with carpenter's instruments in them, so obviously they played a part as well.

The unfortunate fact is that singly and collectively these tools do not explain the full scope of the work. The copper chisel will not cut granite, but copper that is rubbed against quartz sand, which in turn

rubs against stone, will wear both the copper and the stone. The impact of a dolerite hammer or pounder that is struck against a rock surface will crush the surface slightly, and after the loose material is brushed aside, more pounding can remove more material. A flint chisel struck against rock will crush the impact point so that small amounts of rock may be removed to accomplish fine detailing.

All of this work has been demonstrated by experimentalists who have attempted to explain how the ancient Egyptians built their monuments. In fact, a tremendous effort has gone into demonstrating how these simple tools worked and why they belonged in the ancient Egyptian toolbox.[2]

What is lacking in all the experiments that purport to explain how the ancient Egyptians crafted their statues and monuments are detailed manufacturing processes that leave us convinced that these methods are accurate and true to the evidence. To accomplish this, experimentalists must follow these steps:

1. Have experts examine rigorously and thoroughly the original artifact, paying close attention to the most difficult characteristics to reproduce.
2. Describe the theorized method used by the Egyptians.
3. Perform the work, including that which is most difficult.
4. Compare the experimental results with the original artifact—taking into account all the characteristics of the original.

In all cases, experimentalists have accomplished only steps 2 and 3. When steps 1 and 4 have been attempted, evidence has been overlooked or ignored. There is no argument that a hard stone bashed onto a softer stone will remove some of the softer stone. Will a flint chisel in the hands of a careful craftsman enable the craftsman to form stone into three-dimensional shapes such as small statuettes or hieroglyphs? Absolutely! Can quartz sand abrade rock in such a way that it gradually wears away the rock and leaves an impression of the object used to press down on or rub against the quartz? There is no argument that it cannot. An army of researchers could make a million slots in granite

using flat and tubular pieces of copper that rub back and forth on sand, but unless the results match the evidence left behind by the ancient Egyptians, these results prove nothing about the ancient Egyptian stone-working methods. Steps 1 and 4 are not fully satisfied.

What we have been taught is that the ancient Egyptians were in possession of only simple hand tools, and that the only metals available to the Egyptians of the fourth dynasty, when the Giza Pyramids were built, were copper, gold, and silver. What is inferred, therefore, is that absent the tools made from these materials, the simple abrasive experiments actually demonstrate the stone-working methods of ancient Egypt. We are told that the ancient Egyptians had not yet developed the knowledge to extract the raw materials necessary to produce iron and steel. It has been suggested that they may have used meteoric iron, because they found it lying on the ground, but they did not mine the ore and smelt it in a foundry. Support for this view is the lack of evidence that they used tools made of any material other than copper, stone, and wood. Yet absence of evidence is not evidence of absence. Although sophisticated tools made of iron or steel may not yet have been discovered in the archaeological record, what has been found is not adequate enough to explain how the artifacts were created.

In all experimentalists' efforts to convince the public that their theories are correct, not one has provided convincing evidence that what they have accomplished explains all the evidence. There seems to be a tremendous effort not to disturb the status quo when it comes to the stories such scholars tell about ancient Egypt. As long as experimentalists can scratch out a few cubic centimeters of stone using primitive tools, the ancient Egyptians are kept in their place in the history books. They describe to us a sinewy, linear view of history, from club-wielding cavemen to copper-saw-rubbing, dolerite-ball-bashing Egyptians to the Olympic accomplishments of the Greeks and then to the gladiatorial strength of the Romans—and so on to modern Western humans, who exercise their sinews on a treadmill with a symbol of their intellectual muscle in the shape of an iPod strapped to their arm.

In the previous chapters, we have examined artifacts that provide a

basis for the first step in the search for answers to the mystery of how the ancient Egyptians cut hard igneous rock with such proficiency and skill. We have examined the artifacts in their full glory, fully crafted and placed in their intended or subsequent resting places. In order to understand how they came to exist it is necessary to go to the source from whence they came—the quarries at Aswan in Upper Egypt.

In the next few chapters, we will examine in closer detail how Egyptologists have explained how the obelisks of Egypt were quarried and cut. We will review some of the literature that has been written on the subject as well as discuss the work of Mark Lehner, Denys Stocks, and Roger Hopkins in the *Nova* documentaries *Secrets of Lost Empires: Obelisk* (or Obelisk 1) and *Secrets of Lost Empires: Pharaoh's Obelisk* (Obelisk 2).

We will then address a subject that Sir William Flinders Petrie started in 1883, when he described the spiral grooves on an ancient Egyptian granite core as a "drunken screw." I revived the subject in 1984 with a rather controversial theory about how the ancient Egyptians drilled holes in granite that showed a remarkable feed rate of the drill. Rather than focus on my own theory of how such things were accomplished, I will concentrate on those who have published the results of their own experiments, to see if their results are capable of explaining the evidence at hand. This involves my own experiment in performing a granite drilling using a copper tube and an abrasive and comparing the results with the granite core in the Petrie Museum at the University College, London. The results are noteworthy and some of them were unexpected.

9
In the Shadow of an Obelisk

So as regards these two great obelisks,
Wrought with electrum by my majesty for my father
Amun,
In order that my name may endure in this temple,
For eternity and everlastingness,
They are each made of one block of hard granite,
Without seam, without joining together!

Inscription on the base of
Hatshepsut's obelisks in
the Karnak Temple[1]

Of all the iconic symbols of Egypt, the obelisk rises above all but the pyramids, both figuratively and physically. If it had been possible for Western invaders and influence peddlers to cart off the Egyptian pyramids, they probably would have done so, but with the marshaling of sufficient manpower and materials, the coveted Egyptian obelisks made their way intact, and sometimes in pieces, to the favored environs of imperial powers—which were, of course, their major cities such as Lisbon, Rome, Paris, London, and New York.

Although only twenty-nine obelisks survive from the distant past, the ancient Egyptian landscape was at one time dotted with what is estimated to be more than one hundred of these enigmatic shafts of pink granite. They were placed like an arrangement of acupuncture needles that pierced the sky, perhaps to disperse negative forces that occasionally threatened to accumulate among the populace, and served to protect large, open spaces where people congregated in and around temples, where the obelisks stood, normally in pairs, as powerful talismans for the temple and conduits from the empyrean. The obelisk was a focal point that gave the population heart and connection to their solar deity, the god Ra.

The ancient Romans had a passion for carrying off many of Egypt's obelisks, and their labors eventually resulted in Rome having more Egyptian obelisks than those that remained standing in Egypt itself. The obelisk that graces the center of the grand piazza of St. Peter in the Vatican was originally transported from Heliopolis to the Julian Forum of Alexandria under the orders of Emperor Augustus. It is the second largest obelisk in Rome, standing at slightly more than 75 feet (22.8 meters) in height and weighing approximately 330 tons (907 kilograms). In 37 CE, Caligula had the forum demolished, and the obelisk was transferred to Rome. From its place in the center of the Circus, it cast a shadow across the arena where Nero's inhuman taste for blood sports was gratified.

In 1586, Pope Sixtus V, who was known to have spilled his own share of blood while leading his flock, ordered the obelisk to be moved to the Basilica of St. Peter, where a temporary wall was erected while it was hoisted upright. Gathering behind the wall and on every rooftop and terrace in the vicinity, which included the roof of the basilica, an eager crowd strained for a glimpse of the work where Domenico Fontana, the architect who built the Lateran Palace and reconstructed the Vatican Library, directed the gangs that strained against the spokes of capstans. He held his breath, praying that his invention for hoisting the immense

◄ Figure 9.1 (opposite). The obelisk of Hatshepsut in the Karnak Temple

tonnage would hold together and work. Arrangements had been made for Fontana to jump on a fast horse and escape should his enterprise fail, for the heads of those who displeased Sixtus V were known to end up on spikes, after their necks were stretched on the gallows.

During the transportation of the obelisk, the Bishop of Rome exorcized the horizontal shaft in an attempt to eradicate its pagan past and convert it to Christianity. When it was raised to its vertical position and the holy water had evaporated, a Christian cross, blessed by the pope, was affixed to the pyramidion.

The obelisk in St. Peter's piazza does not have the reliefs and hieroglyphs typically found on Egyptian obelisks, such as the one remaining at Luxor and those at Karnak. As seen in figure 9.1 and figure 9.2 these ancient reliefs stand out as a remarkable testament to the capability of the ancient artisans and their tools. Because I had examined the precision and symmetry of the Ramses statues and crowns, I was struck by the incredible beauty and consistency of three-dimensional form in the sunken reliefs on obelisks. On Hatshepsut's obelisk at Karnak (figure 9.1), for instance, the reliefs seemed to display a mechanical accuracy, using many of the same symbols as the obelisk at Luxor.

Some of the reliefs, such as the owls, have an eerie quality (see figure 9.2). With the light shining up the granite shaft at night, there is an optical illusion: After viewing the obelisk for a few moments, the sunken reliefs, their three-dimensional forms illuminated within the deep outline of the figures, appear as bas-relief figures projected outward from the surface of the granite.

While exploring the Temple of Karnak, I came across a piece of granite behind the Ramses statue just outside the Great Hypostyle Hall. It appeared to be part of a broken obelisk, and the workmanship of the reliefs, when seen up close, provided more detailed evidence of the astounding and flawless work of the ancient Egyptians. When viewed from a distance, the profusion of sunken reliefs on all four sides of the obelisks make the structure look like a beautiful piece of art. The right brain takes over, and the senses are overcome by the visual effect. Upon closer inspection of the extraordinary lengths the artisans

Figure 9.2. The obelisk outside the Temple of Amun Mut Khonsu at Luxor

went to in order to execute their design, the left brain takes over, and it becomes obvious to sculptors, artisans, and engineers that the carving was accomplished with a high degree of discipline and with little variation in exactness and form from one relief to the next, from one obelisk to the next.

In figure 9.3, the depth of the sunken relief is consistent with most of the reliefs on the obelisk. To the right of my finger, however, are mere scratches that seem out of place and are, even to the most casual observer, different in quality from what the ancient Egyptian artisans were capable of producing, even on the same piece of granite. This seemed to be a common occurrence, and one that suggests that artifacts crafted by an older civilization were adopted and personalized by later cultures that were not quite as adept, and that did not possess the same kinds of tools as the original artisans.

Figure 9.3. Sunken relief of a Nebet (basket)

As seen in figures 9.4 and 9.5, there is more to the ancient artisans' sunken reliefs than first meets the eye. One of the reliefs next to an owl inspired me to take a wax impression of the inside corner. My interest in this feature was the evidence of a corner radius that appeared to have been cut slightly deeper than necessary and that went below the three-dimensional contours of the relief. Significant in all the reliefs on Egyptian statues and obelisks that I have seen is the shape of the relief defined by a deep cut that is perpendicular to the outside surface, whether that surface is the flat face of the obelisk or the rounded contour of a statue. This particular relief was sunk from a flat face to a depth of approximately 0.5 inch (1.27 centimeters), where it terminated with a radius, though not a true radius from the tangency point of the straight surface.

Though the depth of the relief is technically impressive, the features to the right of where the wax impression was taken are even more so,

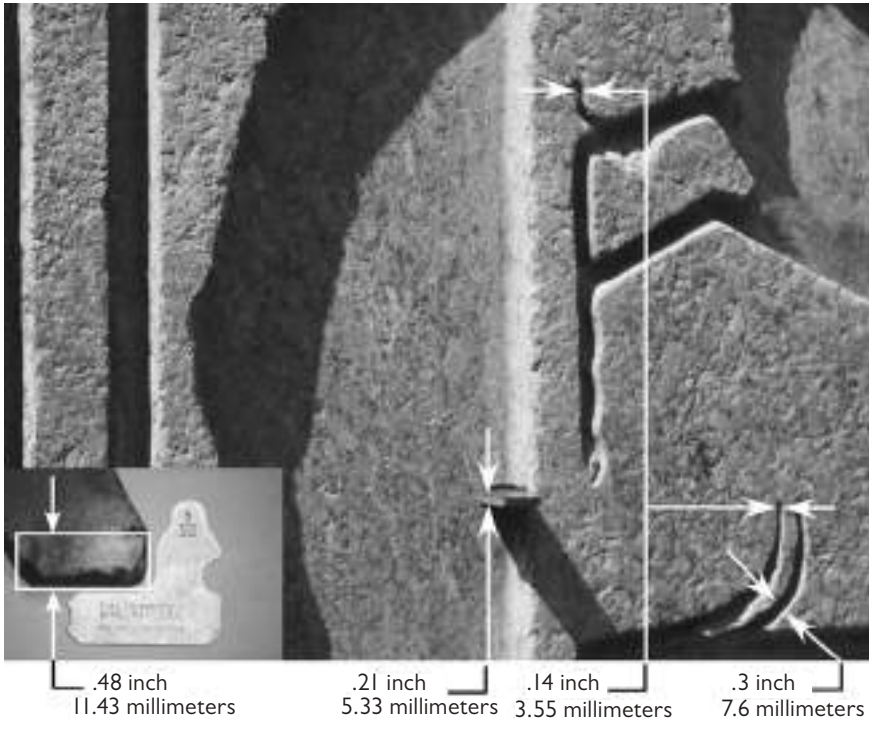
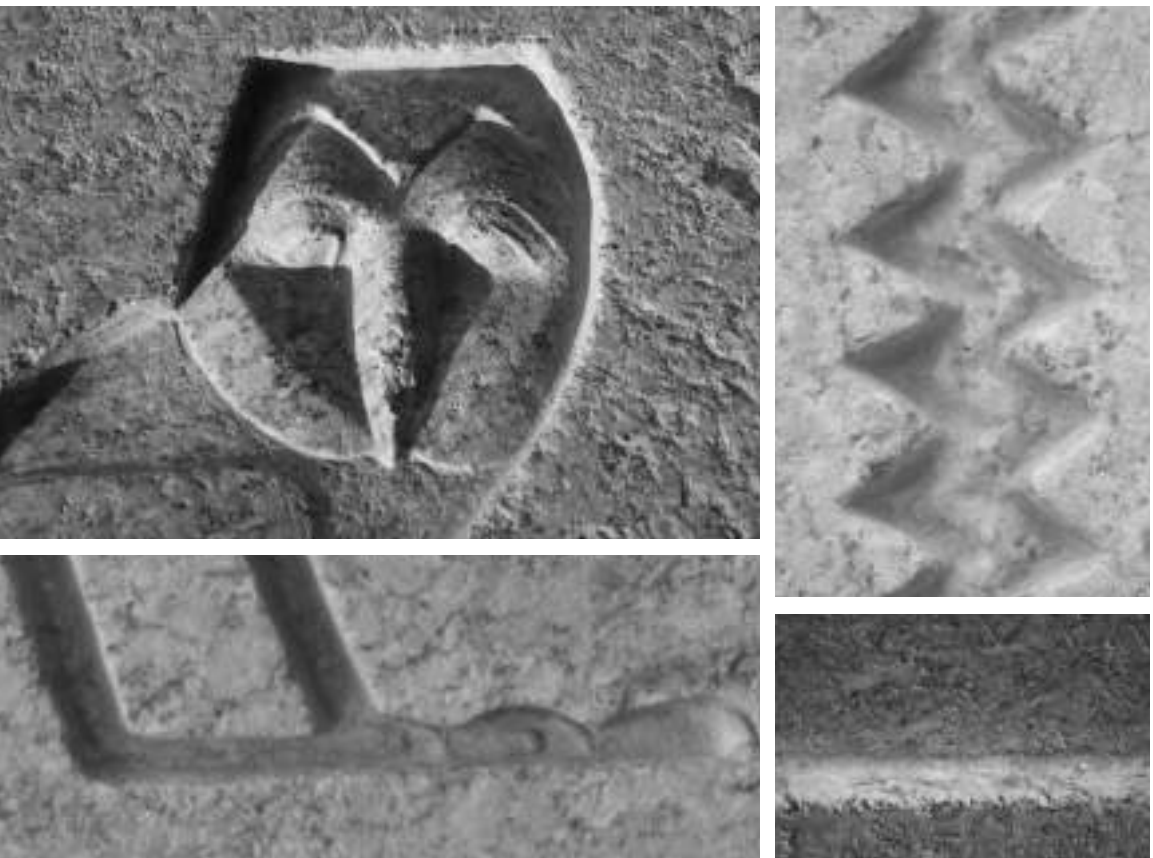


Figure 9.4. Photograph of details of wax impression

and give us a better idea of the capabilities of ancient Egyptian tools. These are the extremely narrow cuts achieved when the artisans created the talons of an owl. The two sweeping arcs start out 0.3 inch (7.6 millimeters) wide and end at 0.14 inch (3.55 millimeters) wide. When compared to the primitive scratches in figure 9.3, there can be no argument that a different class of tool and artisan created them.

The surfaces that outline the shapes of the reliefs and provide their depth are not polished and do not show any marks to indicate that they achieved their final shape by the action of tools that scraped or rubbed along their length to remove discrete amounts of material. Figure 9.5 provides several views of these surfaces, and they appear to have been the result of a tool that plunged straight into the granite, withdrew, moved over, and plunged down again. A template could have been used to guide the tool and achieve the consistency of form that we see on other

Figure 9.5. Examples of deep reliefs



artifacts—particularly on obelisks. To achieve the narrow cuts that are evident in figure 9.4, it would be preferable to repeatedly plunge into the material to create the outline and remove the bulk of the material to form the relief. This is because a tool with a 0.14-inch (3.55-millimeter) cross section is better able to withstand compression forces acting upon it than shear forces acting perpendicular to its length (see figure 9.6).

The figure in 9.5 that represents water or Uat (the zig-zag line) seems to provide confirmation that the outline of the relief was created first and then the material in the center was removed. In this relief, we can see the raised part of the center, which may, considering its width, have been broken down and then smoothed rather than tooled, as the complex, three-dimensional surfaces of other reliefs probably were. The falcon's talons at the lower left of figure 9.5 also give us indications of this.

There are no surviving tools or machines that can be shown to have produced this work. Those that survive are incapable of such accuracy, especially on an industrial scale. There are some controversial theories about how the pyramids of Egypt were built, but the accepted conventional theory of copper chisels and stone or wooden hammers simply does not hold up because such technology cannot reproduce the results we see. Further, because this answer does not suffice, it invites nonconventional solutions.

Yet these are not heard by the general public, who know of only the conventional theories that all children are taught in school and that

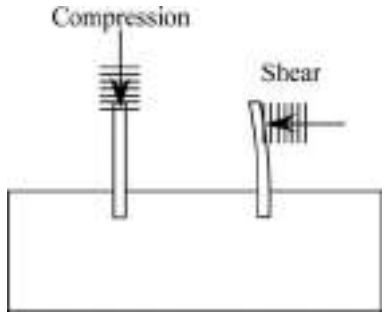


Figure 9.6. Compression versus shear force on tool

audiences see on the Discovery Channel and on PBS when the manufacturing methods of the ancient Egyptians are discussed. On such programs, copper chisels and stone pounders, crude as they may be, are not posited as a *possible* method of manufacturing; their existence in the archaeological record is presented as *proof* that such tools were used to produce the monumental megaliths that dot the Egyptian landscape. Obelisks are a prime example of what such a crude technology was supposed to have achieved.

It is important to give as accurate a description as possible of the characteristics of the sunken reliefs in Egyptian obelisks in order to judge whether modern attempts to show how they were created satisfy the evidence. For instance, in the PBS *Nova* documentary *Secrets of Lost Empires: Obelisk,* Roger Hopkins, a stonemason who participated in the making of this documentary as a consultant and expert witness, discusses the reliefs with Egyptologist Mark Lehner: "Even with modern tools and, you know, diamond wheels and all that, we would have, you know, we would have a tough time getting it to this kind of perfection."[2]

Not deterred by Hopkins's expert opinion, Mark Lehner picks up a dolerite pounder and demonstrates his theory of how the ancient Egyptians roughed out big hieroglyphs using it. After pounding for an hour he sincerely declares: "I'm convinced that with their skill and their rapport with the stone and a great deal of time and patience, that this is the way they carved the fine details like the hieroglyphs on the obelisk."[3]

Lehner points out that scenes in Egyptian tombs indicate that workers are sanding and tapping out details of a statue using stone chisels and refers to drawings in the tomb of Rekh-mi-rē, who was a governor of Thebes during the reigns of Tuthmosis III and his son Amenophis II. His lavishly illustrated tomb contains many scenes of the craftsmen he oversaw, including sculptors depicted in figure 9.7. Illustrations such as these are used by Lehner and other Egyptologists as proof that the methods suggested by tomb drawings were the ones used to craft colossal statues and obelisks, with their deep sunken reliefs.

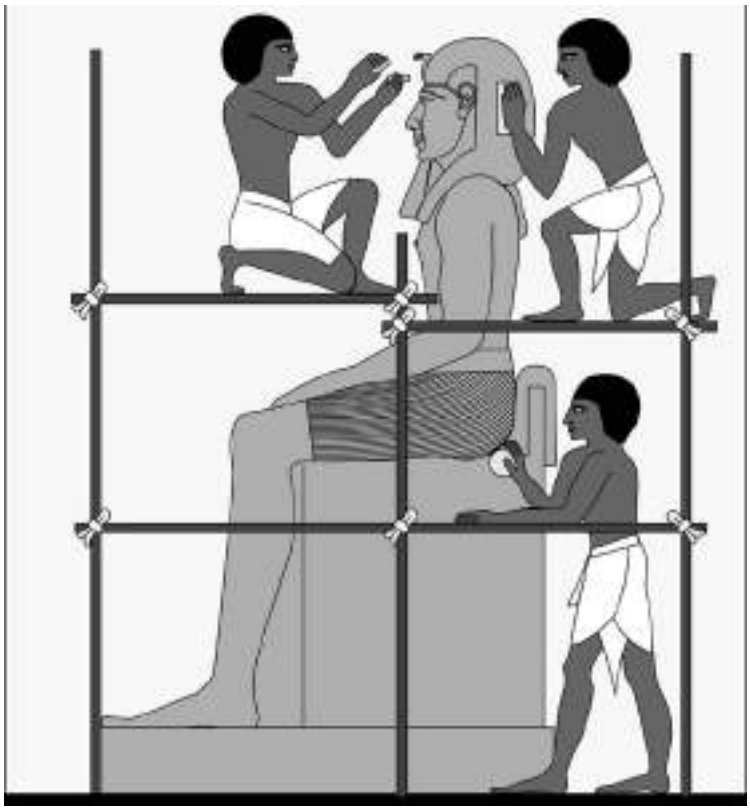


Figure 9.7. Depiction of a statue being worked on in the tomb of Rekh-mi-rē at Thebes. Drawing by C. Dunn, adapted from http://history.memphis.edu/hypostyle/Tour/building5.htm, with Ramses likeness added.

To his credit, Lehner admits that his efforts fell short of the quality of the ancient work on the simplest of shapes: the symbol for Ra, or the sun. His efforts produced a very shallow and rough relief compared to the original smooth, perfect profiles that are incised almost 1 inch deep. If he had managed to sink a perfectly formed falcon with narrow cuts of 0.14 inch wide, he might be able to argue that what is seen in figure 9.7 is an accurate representation of how the ancient Egyptians may have performed such intricate carvings.

Yet lacking replication of the more difficult accomplishments of the ancient Egyptians using such methods, the tomb drawing does

not explain the Ramses statues, and we cannot help but wonder what knowledge the artists in Rekh-mi-rē's tomb possessed about how the Ramses colossi were actually made. Was Rekh-mi-rē a prolific theorist in his day, and are these drawings mere speculations on how these colossal statues were created? Or is it possible that they describe how workers cleaned the statue and that what has been interpreted to be stonework tools may merely be sponges or sticks for cleaning out the corners? Either way, the evidence of the tomb drawings is hearsay, and the question remains regarding the correctness of connecting them to the hard evidence on the ground, which we cannot replicate when we use these tomb drawings for guidance.

Regardless of the ideas that are offered to explain how an object can be created, what counts are the results and how closely the results produced using those theories as guidelines conform, in this case, to the results produced by the ancient Egyptians. What results would we look for, then, to prove that the methods used by the ancient Egyptians to quarry, shape, sculpt, move, and erect a 400-ton obelisk have been demonstrated?

Lehner arguably does not prove methods in his obelisk documentary. For starters, the obelisk he uses is only 40 tons, and the reliefs that the cuts are not even close to the quality of the ancient reliefs. Another Egyptologist who was a part of Lehner's team, Denys Stocks, omits from his report a complete engineering description of the original artifact and clear photographic evidence of the artifacts that he attempts to replicate to prove his point. Although Stocks shows that he could chisel an ankh into soft limestone with a copper chisel, in his book *Experiments in Egyptian Archaeology,* he neglects to thoroughly describe the ancient Egyptian reliefs so that readers can compare his results with the originals. Also, his experiment in drilling granite using a copper tube neglects to describe the tool marks of ancient core drilling, as discussed by Petrie. We will address this topic in greater detail in the next chapter.[4]

Lehner mentions that having a rapport with the stone would bring greater success. This has a nice ring to it, because artists do connect with

the materials they work with and seem to develop an inner knowledge of how the material will respond to their touch. This quality of work is not necessarily quantifiable in a scientific sense, but rather is a unique gift that artists and sculptors possess. It was important for me, therefore, to seek the opinion of a modern sculptor who had gained a rapport with the material he has worked with over many years and who has produced significant works of art. I contacted Mike Leckie, a modern sculptor who has crafted many kinds of marbles, limestone, alabaster, and other rocks into incredibly beautiful shapes. His website presents photographic evidence of and commentary on the stages of creating a statue in marble. Figures 9.8 and 9.9 are photographs of a finished work that can be seen in progress at www.mikeleckie.com/in-progress-marble.html and are reproduced here with his kind permission.

Figure 9.8. Mike Leckie's *Bather in Marble,* front

Figure 9.9. Mike Leckie's *Bather in Marble,* back

I was anxious to get Mr. Leckie's opinion on the Ramses statues at Luxor, and I forwarded to him my text that addresses those incredible works. In response, Mr. Leckie wrote to me his expert opinion on these immense accomplishments of art and engineering:

> March 18, 2009
> Dear Chris,
> Thank you for this opportunity, I have been interested in Egypt and its sculpture since I was a child.
>
> As a stone sculptor, I can say that the granite of the Ramses head and figures is an extremely hard stone, and I believe tools much more durable than hardened copper chisels must have been used in the carving process. It would be necessary for me to upgrade my normal tools to carve such granite. My modern diamond blades and grinding points would be worn out before the head was started. The ancient carvers must have had advanced technology.
>
> Although the ancient Egyptians had stone chisels and hammers, which could cut the extremely hard granite, even with an army of disposable labor, completing four large sculptures exactly alike with hand tools would take more time than we can conceive of as possible. Modern man with all his modern tools would be challenged to finish one Ramses in a generous timeline. Creating four of them as large as they are, all the same, seems almost impossible.
>
> Best regards,
> Mike Leckie
> www.mikeleckie.com

From the time of Greeks until modern times, sculptors have preferred to work in stone other than granite, though with the rise of modern steel tools and materials, granite has been used on occasion.

The documentary produced by Lehner et al. is an interesting study that purported to demonstrate how the ancient Egyptians were able to quarry, shape, and incise deep reliefs into obelisks, transport the obelisks over many miles, and then pivot them into a vertical position on

a pedestal within or in front of a temple or other important building. It is important to note that the documentary's results fail in every way to demonstrate the more difficult aspects of the work. Nevertheless, it is an enjoyable study, thanks in part to the irreverent good humor of stonemason Roger Hopkins.

During the making of the obelisk documentaries, which were broadcast by PBS's *Nova* in 1999 and 2001, Peter Tyson, the online producer for *Nova,* went to Hamada Rashwan's quarry, which had been contracted to provide the *Nova* team with an obelisk for their experiment. There, Tyson interviewed Rashwan, an engineer and the owner of the granite quarry, which also provides some labor for the experiment. Rashwan has been in the quarrying business for twenty-nine years. Tyson asks him if he has learned anything from his ancestors about quarrying and moving granite. Significantly, this man who has been around the quarrying of Aswan granite for a lifetime, replies: "Yes, of course, because as you know, all the ancient Egyptian obelisks were produced in this area, the Unfinished Obelisk area. I don't think the ancient Egyptians used people, the workers, to raise obelisks. They used very advanced engineering techniques. I think that is the true way."[5]

Considering the difficulty and effort involved in moving obelisks from Egypt to Rome or London or New York, we might well ask why the Romans, English, French, and Americans didn't go to their own quarries and, with their modern iron tools, simply create obelisks of their own? Certainly, they wouldn't have had to move them as far, and the risks involved in seafaring would not be an issue. The answer to this question is better understood after a trip to the Unfinished Obelisk at Aswan, where the *Nova* team, following in the footsteps of other researchers, tries their hand at quarrying a 9-ton obelisk near to where the original 1,200-ton mass rests, as it has for millennia, still attached to the bedrock.

Roger Hopkins is tasked with carving out an obelisk using the tools that Egyptologists maintain the ancient Egyptians used. For quarrying, they theorize that dolerite pounders—dolerite is a very hard, greenish rock—were wielded by hand and bashed against the granite. The balls are 5 to 12 inches in diameter and weigh an average of 12 pounds (see

figure 9.10). As Hopkins works away at his task, Mark Lehner demonstrates how he believes the ancient Egyptians worked the granite in the tight confines of a deep trench that is only 26 inches wide at its widest point. As his workers scrape the bottom of the trench with their dolerite pounders, they respectfully avoid removing any of the granite.

Hopkins has been at the task for seven days when Lehner approaches him to view his progress. Lehner is not impressed, to say the least, for Hopkins had made very little headway, but proposed that he speed things up using more modern techniques.

This is not the first time Hopkins has been involved with Lehner and has had to call in modern tools when running into difficulty with supposedly ancient methods. *Nova*'s "This Old Pyramid" documentary had similarly run into difficulties using "ancient" techniques in the creation of a small pyramid. Lehner and Hopkins had to resort to steel tools and heavy machinery to lift most of the blocks that went into it.

There is some confusion regarding the exact amount of material removed in an hour in Hopkins's and Lehner's experiment. At one point, Lehner mentions that in two to three hours, 2 millimeters had

Figure 9.10. Dolerite ball at the Unfinished Obelisk (Photograph courtesy of Dan Hamilton, 2004)

been removed from a small square patch, presumably one quarter of the size of the patch assigned to a worker in the trench. If we calculate the amount of material removed per hour in the Hopkins and Lehner efforts, we learn the following:

LEHNER AND HOPKINS

Width of square	12 inches	30.48 centimeters
Depth of square	0.078 inch	0.2 centimeter
Hours worked	2.5	2.5
Cubic mass/hr removed*	4.493	74.322
Weight of granite/cubic measure†	0.097 lb	0.0027 kg
Total weight of granite removed	0.436 lb	0.201 kg

*The calculation used to determine cubic mass per hour is (width × width × depth) ÷ 2.5.
†Weight of granite = 168 lb/cu.ft; 2691 kg/cu.m

While at Hamada Rashwan's quarry, *Nova* producer Peter Tyson also tries his hand at quarrying with a dolerite pounder.

> I got a nasty taste of their job—minus the cramped space and the pressure to succeed. Cupping a greenish-black dolerite ball in my hands, I brought it down with a crack onto a block of granite. Over and over, I bounced it on the same spot, till I thought I'd scrape the skin off my palms. After ten minutes, my wrists hurt from trying to guide the 12-pound rock in at an angle—the better to break the granite—and stabs of pain began shooting up my arms. Mark Lehner recalled that after once pounding for several hours, he could barely type on a computer: ("All I wanted to do was smash the keys," he said.) I did it for only 20 minutes, and all I had to show for it was a baby's palmful of granite dust. And the granite's surface looked no different than when I'd started.[6]

Three baby's palms filled with granite dust after one hour of pounding would be somewhat dispiriting. Nonetheless, my own efforts were

no more successful when I attempted the same thing in 2006. The midday sun beat down unmercifully as I walked along the meandering granite path around the Unfinished Obelisk, an ancient relic that had seen the same sunrise a million times since it was abandoned by the quarrymen. The hill was pockmarked with the remains of ancient slots that were cut by masons in order to split granite blocks from the stone faces. Little is known about the original topography of the site because this quarry had been worked for millennia. Across the length and breadth of Egypt, millions of tons of Aswan granite can be found in the shape of building blocks, architectural elements, statues, and, most prominently, the famous obelisks that pierce the sky like giant punctuation marks, commanding visitors to look upward and know their place and mortality in an ancient and infinite universe.

I had plenty of water, an Egyptian *agal* (braided headband), and a *keffiyeh* (white cotton scarf) thrown to me by merchants in feluccas who had approached our Nile boat the previous evening. The Arabic strains of the soulful singing of Oum Kalthoum from our Arabian Nights evening had faded in my head, to be replaced by Noel Coward's famous lampoon of British colonial mentality, "Mad dogs and Englishmen go out in the noon day sun." I searched indigenous faces for signs of mirth. There were plenty.

"What's your name?" asked a cheeky young boy with a smile on his face and trinkets in his outstretched hand.

"Christopher." I replied. "What's yours?"

"Mohammed," he replied. "Welcome to Alaska!" he laughed.

"Al hamdu lilla" (praise be to God), I replied, soaking my scarf with water and securing it to my head with my agal. I love Egyptian quick-witted humor, and they love foreigners who can join them in making fun of—foreigners—and there's plenty of fun to be had in Egypt. The scarf blocked the sun, and the slight blowing breeze created a natural air-conditioning effect. It was practical, but not quite a dashing Indiana Jones look.

As I approached the obelisk, which is still attached to the bedrock against the granite hillside, I remembered when I first visited in 1986,

upon the advice of an Egyptologist in the Cairo Museum. Twenty years later, I noticed that the site had changed drastically. Instead of ascending a staircase straight up to the middle of the obelisk, a path with occasional steps wound around what would have been the pyramidion that crowns the traditional obelisk. Though money changed hands, there were no tickets sold in 1986, so there was no reception area, ticket booth, or gate to pass through, as there are today. Also missing back then were the ubiquitous guards that are now posted with rifles at every high point in the vicinity—a necessity given the existence of terrorists striving to kill tourists in order to destabilize the government. Of course, in 1986 there were few tourists, but in 2006 they flock to the site daily. In 1986, the only vehicle in the vicinity was the taxi that drove us to the site, and I had the entire quarry to myself.

The Unfinished Obelisk offers compelling indirect evidence regarding the level of technology its creators had reached—not so much by indicating clearly what methods were used, but by the overpowering indications of what methods could not have been used. I was not the first to realize the significance of the Unfinished Obelisk's sober challenge to theories about the methods employed by the ancient Egyptians in quarrying and shaping granite. The value of this artifact is that it provides an important contribution to the complete story of how obelisks were made—from the raw bedrock to the finished items that proudly stood in prolific number throughout Egypt.

Lehner, Hopkins, and I (independently and separately) came to the Unfinished Obelisk sixty-five to seventy-five years after it was first revealed to the modern world in its full glory. Between 1921 and 1922, Reginald Engelbach (1888–1946), the chief inspector of antiquities in Upper Egypt, undertook the task of having the rubble cleared from the trench that surrounds the obelisk, and, in 1923, he wrote an exhaustive study titled *The Problem of the Obelisks:*

> Before the clearance, all the visitor could see of the obelisk was the top surface of the pyramidion and about 20 yards of shaft, which sloped down into a vast heap of sand, chips and granite boulders. It

has now become one of the most visited sights in Aswan, since nothing of its kind is to be seen elsewhere.

Most persons, having seen the temples and tombs of Egypt, become more or less blasé to them. This is largely due to the fact that no-one—least of all the dragomans [guide or interpreter]—brings home to them the enormous difficulties the Egyptians overcame. They dismiss them as beyond their understanding, and many closer students of the monuments than the average visitor have boldly affirmed that the Egyptians knew engines and forces of nature of which we are to-day ignorant. This is quite a wrong idea; it is, as a matter of fact, far easier to explain every step in the mechanics of a large obelisk to the non-technical reader than those of an iron bridge. Though modern research robs the Egyptians of the magical powers attributed to them, it makes them more admirable in the eyes of the practical man, as it shows that they could do, with the most primitive tools, feats of engineering which we, with some 3,000 years of mechanical progress behind us, are barely able to copy.[7]

Engelbach's Measurements of the Obelisk
Length: 137 feet
Base: 13 feet 9 inches
Pyramidion base: 8 feet 2 inches
Pyramidion height: 14 feet 2 inches
Weight (if it had been extracted): 1,168 tons[8]

Little seems to have changed since Engelbach's time. Alternative ideas were expressed about the Egyptian monuments even in the 1920s and were summarily dismissed in much the same way as they are today. Yet in a discussion with an Egyptologist with the Department of Tourism in 2004, I was told that every time she accompanies engineers around the Unfinished Obelisk, they dismiss the official theory as unworkable

Figure 9.11 (opposite). The Unfinished Obelisk ►

and start discussing how it really could have been accomplished. This may be considered hearsay, or worse—thought of as pandering—but it rings true to me, for I too have been in the company of engineers who are of the same mind and engineers are not known for pandering, especially toward other engineers. If everybody knew of Engelbach's work and his opinion of such speculations, would these types of conversations still take place? They most certainly would.

It is postulated that the obelisk was abandoned because a crack had developed during the quarrying process. This seems to be a logical assumption, and it is commonly accepted to be true. Yet having invested such a huge effort in the trenching process, the ancient Egyptians—if they were continuing to create sarcophagi, statues, and other building blocks—could still use the cracked obelisk for a great deal of usable stone that was not cracked. They would merely need to cut the quarried piece into shorter sections to get some good stone for their labor. In fact, it appears that this is what was attempted in an area near the pyramid-

Figure 9.12. Series of drilled holes on top of Unfinished Obelisk

ion, where there is a series of holes drilled in a line (see figure 9.12).

The line of drilled holes seems to outline a small obelisk, if you take into account that the outline also includes the groove, which may have originally been a line of holes before being dug out. Considering that the outline crosses the crack to what might be the pyramidion, it would indicate that when they were drilled the obelisk had not yet cracked. Was the crack that has long been theorized to be the reason why the obelisk was abandoned actually caused by work performed at a later date? It seems unlikely as fissures are in abundance throughout the granite bedrock, and this fissure through the granite appears to coincide with a fissure in the bedrock hill to the south (see figure 9.11).

Why the obelisk was abandoned will probably always be a mystery. There are no records that tell us that the quarry workers expended an enormous amount of resources on the granite hill and found a crack, so they picked up their tools and went to hammer somewhere else. We could speculate that all work ended while the obelisk was being excavated because of a cataclysmic event that disrupted the Egyptian civilization. All quarrying ended at Aswan and elsewhere, and it wasn't taken up again until the Romans controlled the country in the first century BCE. In fact, the unfinished obelisk may be the last artifact to be quarried in ancient Egypt, and as such, it would represent the state of the art in quarrying and moving large objects—notwithstanding the fact that it was not moved.

As I walked around the obelisk, I noticed several areas that display evidence that has been used to lend support to the traditional theory of how the ancient Egyptians quarried granite. Egyptologists posit the simplest of methods for shaping stone. Natural materials such as dolerite are drawn from the earth with no further value added to them. The pyramidion and other parts of the obelisk have several shallow depressions that have been shaped by an object that left rounded corners at its perimeter. Nearby, a shelf of granite has the same marks, and these rounded features are commonly seen at the bottom of the deep trench that defines the shape of the obelisk. All over the quarry and in the trench around the obelisk dolerite stones were found in antiquity so it is

natural to conclude that the marks left in the trench around the obelisk were created using dolerite pounders.

I walked a short distance away from the base of the obelisk to an area where granite blocks and dolerite balls were found lying around. I pondered the traditional theory while picking up one of the balls and wondered whether I was holding what amounted to a red herring and the rounded features that are seen on the surface of the granite were created by some other method? While I had always questioned this theory, after trying my hand at the methods suggested by Engelbach, my skepticism increased.

Visitors to the Unfinished Obelisk approach it from the north and follow an eastern path around the pyramidion. They can encircle it to the west, where a viewing platform is located. The retaining wall present in 1986 was removed, and the bedrock slopes down to the obelisk, where visitors can get a clear view of the trench. When I revisited in 2006, I went over to a block of granite near the platform. It looked as though someone had been there before and had been bashing at the surface. I picked up one of the dolerite balls that were lying in the vicinity and started to pound on the already bruised granite, taking note of the amount of material I was removing.

The trick to working granite using a dolerite pounding ball is to allow gravity to do most of the work. If the ball is smashed against the granite with the hands in full contact with the ball and adding weight behind the strike, severe damage to the user can occur over time due to the forces acting on the muscles and connective tissues in the arms, hands, and wrists. Those who have attempted to force the ball against the granite without releasing it have, as Lehner complained, suffered after just a short time.

The same results can be achieved without significant pain to the user if the dolerite ball is released before it hits the granite block. Nonetheless, as I went at it using this method, the results were not much better. Raising the pounder about 3 feet from the granite surface, I rapidly brought it down and released it just before it struck. I was rewarded by a puff of dust from the granite's surface. I tried to build a rhythm

and imagined getting into a hypnotic state with ancient chants timing my swing so that all thoughts of how miserable the job was could fade away and it was just me and the granite and the smack, smack, smack of the ball all day long. It was impossible. Catching the ball became very tricky; it did not always rebound off the granite along its original path. In fact, the task became quite dangerous as the ball bounced in unexpected directions. The uncertainty of the method meant my mind had to be alert. Moreover, after striking the granite successfully for about five minutes, a layer of granite dust covered the surface of the stone and had to be removed because it served as a cushion between the ball and the granite. The removal of waste from a cramped space would have been a significant consideration, as it is in all manufacturing and excavation processes. Notably, the surface finish of the granite created by the dolerite ball did not resemble the surfaces that define the obelisk.

My efforts yielded no better results than those of Lehner, Hopkins, or Tyson. Like Tyson, I was not constrained by the trench walls, nor did I have the risk of striking my toes or anyone else's toes who happened to be next to me. Climbing into the trench, the uncertainty of success using these methods became even more obvious. There is not much room down there (see plate 18), and while anyone can crouch down and strike a ball against the bottom of the trench, the efficiency of the process would diminish significantly as the corners were worked. With a round ball, the flat horizontal surface would diminish as long as the worker was increasing the depth of the channel and not working out the corners. At some point, the corners have to be worked on, which means that the ball could not be released from the hands without bouncing off at an angle (see figure 9.13).

Theoretically, that angle is predictable, but not if the ball is egg-shaped or irregular, as was mine and as were all others that were lying around. Depending on how the ball hits the granite, it becomes quite difficult to catch and maintain a rhythm. Back at my horizontal surface, puffs of dust rose from the granite as the ball came up and fell again. After several minutes of this exercise, very little material was removed, but the nearby 13-foot-9-inch (4.19-meter) deep troughs with several test

Figure 9.13. In the obelisk groove at Aswan

bores cut even deeper, bore stark unadorned testimony to the full scope of the work, and I questioned whether people who only knew of this inferior method of material removal would even conceive of taking on such a project.

Engelbach speculated that approximately one hundred thirty quarrymen worked in the trench at the same time, and each worked an area of around 26 square inches. His own experiments were unusually successful compared to the experiments of those who followed him, and he reported the following results:

> To return to the trench, it is interesting to speculate on the amount of time which was expended in making it. To ascertain this, I tried pounding for an hour by hand at various times on one of the quarters of a two-foot task, and I found that I had reduced the level by about 5 millimetres (0.2 inches) average. With practice I could perhaps have done more. Let us assume that the ancients could extract 8 millimetres (3.15 inches) [sic], [should be 0.315 inches or 8 millimeters] per hour from a similar area; then the time taken to make the trench must be the time taken to do the deepest part. In this obelisk the trench would have to be 165 inches [419.1 centimeters] to make it of square cross section and we must allow at least 40 inches [101.6 centimeters] for the under-cutting (p. 49), making a total depth of trench required of 205 inches. Supposing that 3.15 inches [should be 0.315 inches] were extracted from a quarter of each party's task per hour, it will require $4 \times 205 / 3.15 \times 12 \times 30$ or 7.2 months of twelve hours per day. The undercutting would have taken at least as long again, even though it could be done from both sides at once.[9]

From Engelbach's description of his own performance, he was inside the trench when he worked. He says: "I tried pounding for an hour by hand at various times on one of the quarters of a two-foot-task." This statement also indicates that the work was not conducted continuously for one hour, but "at various times," which indicates that he had rested in between the various times that he pounded.

Adding together each of the various times, Engelbach pounded for a total of one hour and had reduced the level of a 12-inch (30.48-centimeter) patch by 0.2 inch (5 millimeters). Comparing Engelbach's success with Lehner's, Tyson's, and my own, the amount of material he removed, if calculated properly, would be five to eight times the amount we were able to achieve. Yet there is uncertainty behind all of our efforts because no one made an accurate description of the granite before and after the work was performed. Nor were any measurements of weight taken to determine if the amount of granite removed was actually as stated.

The profile of the trench with their rounded corners shown in figure 9.13 pose a serious question as to whether Engelbach's material removal was the same across the full surface of the 12-inch square patch and included the rise to the wall of the obelisk or the bedrock, depending on which side of the trench he performed his tests. To be confident that he had done this, we would require a more complete description of how he had arrived at his measurements. This description should include measurements from a flat horizontal plane to various points on the concave surface of the patch, including up the side of the radius to the wall, and then, after the work was performed, more measurements must be taken from the same flat horizontal plane to the same points. As it is, we have only Engelbach's statement that he was able to reduce the level of the granite by 0.2 inch (5 millimeters).

Even if Engelbach had worked on a 12-inch square flat area and reduced the amount by 0.2 inch (5 millimeters), questions would still remain regarding the difficulties associated with dolerite balls and a horizontal-to-vertical corner radius and how they affect any conclusion we might reach in calculating the entire 13-feet-9-inch depth of the trench. As seen in figure 9.14, reducing the level of a 12-inch patch by 3 inches using a 6-inch ball would leave 11 percent more material in the corners than if the corners were squared. But this material would eventually have to be worked out by attacking the sides, or the trench would become narrower and narrower. Bringing the ball down vertically onto a horizontal flat surface of the granite provides the greatest force and, therefore, the greatest material removal. When the rounded corners

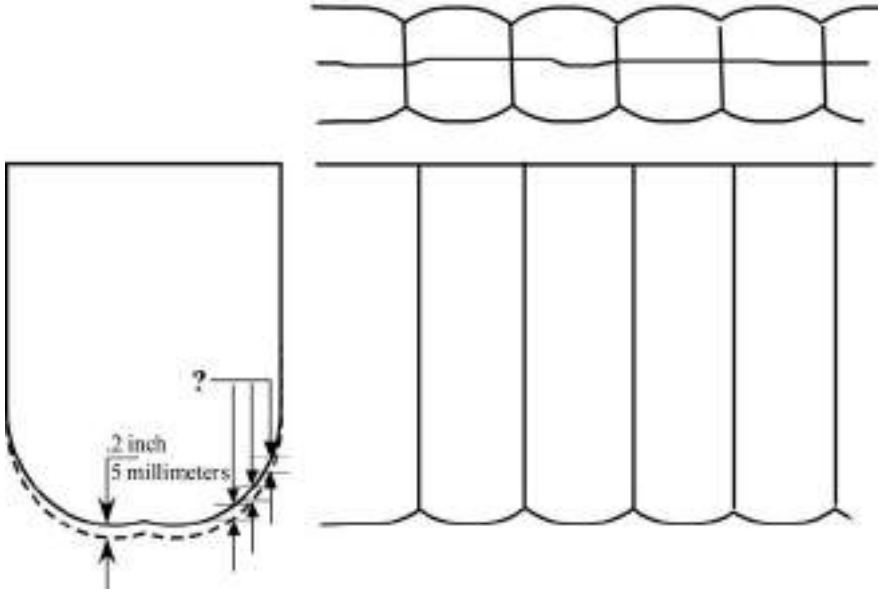


Figure 9.14. Cross section of obelisk groove at Aswan

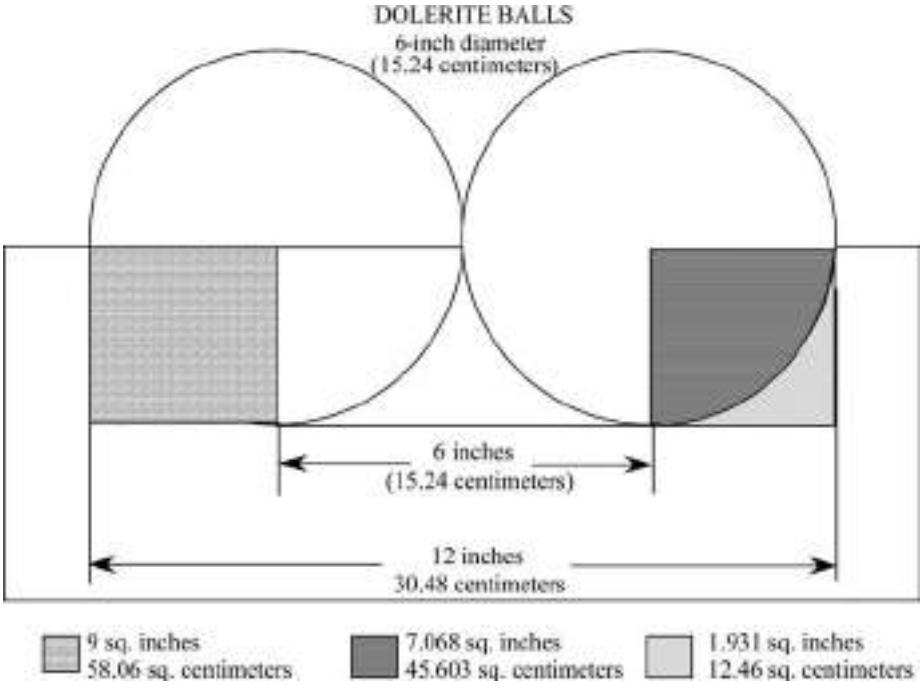


Figure 9.15. Surface area considerations using a round ball

must be worked, the ball has to be guided on an angle or, if applied vertically, it delivers a glancing blow. Either way, the ball will bounce off to the side and become difficult to handle. Lehner's obelisk documentary shows the workers in the trench scraping rather than bashing the corner radius with their pounders.

Engelbach discusses the use of rammers, in which the dolerite is lashed to long pieces of wood and thrust like a spear against the granite. Theoretically, there may be some merit to this method, but its practical application raises the question of how much force could be applied to the wood and rope before either material failed. This becomes significant if we consider the difference between what Engelbach proposes and the information I received in an e-mail from Denys Stocks on October 31, 2001, about his experiments with dolerite pounders.

Mr. Stocks estimated that his removal rate of granite for flattening prior to chiseling a hieroglyph using a stone chisel was around 20 to 25 cubic centimeters in 45 minutes. This calculates to about 26 to 33 cubic centimeters per hour. I used this calculation in an article I had written for *Atlantis Rising* titled "The Obelisk Quarry Mystery," which was republished in an anthology titled *Forbidden History*.[10] In the article I had used Stocks's material removal rates and calculated how long it would take to pound out a proposed workman's patch down to the deepest level necessary to define the features of the obelisk. Following the article, I received a recommendation to access Engelbach's book *The Problem of the Obelisks.* I had assumed that Stocks's more current information would have been sufficient, but Engelbach, unknown to me at the time I wrote the article, by virtue of his exhaustive study and publication, was considered to be the authority on the obelisk-quarrying mystery.

It was also pointed out to me that Stocks's material removal rates applied to flattening a piece of granite and were not quarrying rates. This seemed a slight quibble, for I had asked for material removal rates and did not specify quarrying or dressing/flattening granite. The limits of the tool indicated to me that whether we used the term *quarrying* or *flattening,* bringing a dolerite pounder down with full force onto

granite would yield the same results. The only difference might be an occasional check with a straight edge to inspect the flatness of the surface. Certainly, from my own experience using a dolerite pounder, there wasn't too much worry about overshooting a flat surface if an additional blow or two was taken before inspecting. Nonetheless, because Engelbach was not discussed in the article, it was considered incomplete and my calculations incorrect. Fortunately, I am now able to address that oversight.

Providing a reasonable conclusion that establishes an accurate length of time to quarry the obelisk using published information demands further field research and gathering of accurate information. For instance, the difference between Stocks's and Engelbach's material removal rates is so vast, it is impossible to reconcile. A fairly regular cadence for repeatedly pounding a stone ball against a hard surface would be about sixty times per minute, with the ball being lifted about 3 feet and brought down against the rock. This was about average for the beat I used in 2006. Using this beat, I could have accomplished the same flattening as Stocks—that is, flattening a small area of the granite. What is puzzling to me, though, and casts doubt on Engelbach's results, is that his material removal rate was stated to be 464.51 cubic centimeters/hour while Lehner's was 74.32 cubic centimeters/hour (my estimate of Lehner's based on his statements made on the *Nova* documentary) and Stocks's estimated 30 cubic centimeters/hour.

ENGELBACH'S EXPERIMENTAL RESULTS

Width of square	12 inches	30.48 centimeters
Depth of square	0.2 inch	0.5 centimeter
Hours worked	1	1
Cubic mass/hr removed	28.800	464.515
Weight of granite/cubic measure*	0.097 lb	0.0027 kg
Total weight of granite removed	2.794 lb	1.254 kg

*Weight of granite = 168 lb/cu.ft.; 269 kg/cu.m

Engelbach had somehow managed to remove in an hour 6.25 times the amount of material than Lehner removed in his experiment—but he does not stop there. He speculates that the ancient Egyptians would have increased what he was able to do by 63 percent, which is ten times more than Lehner was able to accomplish.

ENGELBACH'S THEORIZED ANCIENT RESULTS

Square Width	12 inches	30.48 centimeters
Depth of Square	0.315 inch	0.8 centimeter
Hours worked	1	1
Cubic mass/hr removed*	45.360	743.224
Weight of granite/cubic measure	0.097 lb	0.0027 kg
Total weight of granite removed	4.400 lb	2.007 kg

*Weight of granite = 168 lb/cu.ft; 2691 kg/cu.m

In Stocks's, Lehner's, and Engelbach's experiments listed in the tables above, there is uncertainty, and the difference between Engelbach's and Stocks's results is even more pronounced. Engelbach's material removal rate is fifteen times greater than that of Stocks—but then he ignored his own results and credited the ancient Egyptians with removing 63 percent more material than he had removed himself in the same period of time. If we consider what might be necessary to achieve this difference, we may say that Stocks was applying fifteen times less force than Engelbach in a given period of time. This would be equivalent to four blows a minute to Engelbach's sixty blows, or Engelbach's nine hundred blows to Stocks's sixty blows—which is impossible. Even the difference in the weight of the ball does not lead us to a satisfactory answer. If Engelbach's dolerite pounders were fifteen times bigger than those used by Stocks they would exceed the width of the channel. Besides, Engelbach told us that "these balls measure from 5 to 12 inches in diameter, their weights averaging 12 pounds."[11] Could it be that Engelbach was applying fifteen times more force on the granite than Stocks? Having hefted dolerite pounders within that range, and

having bashed them into granite repeatedly, I'd have to say no.

We also have Engelbach's unfounded speculation that the ancient Egyptians were able to remove 63 percent more material in an hour than he claimed to have removed, which would make their efforts twenty-five times greater than those of Stocks. Suffice it to say that there is more than enough reported variation in the material removal rate of granite by researchers that the whole idea of this method being used to quarry obelisks is fragile and subject to serious questioning.

Neither should it go without notice that in the back of Engelbach's mind was the translation of an inscription describing the time frame in which the ancient Egyptians had quarried, dressed, moved, and erected Hatshepsut's obelisk at Karnak, more than one hundred miles away. The inscription at the base of this obelisk is translated by Engelbach:

> . . . so surely these two great obelisks, which My Majesty hath wrought with electrum for my father Amûn, that my name may abide in this temple eternally, are of one block of enduring granite, without seam or joining. . . . My Majesty exacted work thereon from the (regnal) year 15, the first of the sixth month (of the absolute year) until the year 16, the last day of the twelfth month, making seven months of exaction in the mountain.[12]

With his optimistic ancient quarrying rates, Engelbach gave 7.2 months for carving the channel and undercutting the obelisk in order for it to be separated from the bedrock. Yet he presents conflicting and confusing data when he addresses how the undercut could have been carved. He adds 40 inches for the horizontal undercutting of the Unfinished Obelisk, reaching a total of 205 inches, using that dimension as part of his calculation. He then states that "the undercutting would have taken at least as long again, even though it could be done from both sides at once."[13] From this I take it that the 40 inches were added to accommodate the quarryman, who, after reaching the total depth of 205 inches, had to work horizontally beneath the obelisk. Yet in making his calculations for Hatshepsut's obelisk, Engelbach writes:

> Before leaving the subject of the time taken, let us apply the results obtained from my pounding experiments to the obelisk of Queen Hatshepsôwet at Karnak, of which the measurements are given on page 30 [given as base 7.9 ft pyramidion base 5.8 ft pyramidion height 9.7 ft. total height 97 ft. weight 323 tons]. To the base measure of 94 inches we must add, say 30 inches for undercutting, making a total depth required of 124 inches. Calculating in the same way as before, we find the time necessary would be 4.4 months, working twelve hours a day. For detaching it from below we may add a similar period, making 8.8 months.[14]

At 8.8 months, Engelbach's hypothetical quarrymen would already have exceeded the time it took for Hatshepsut's obelisk to be quarried, moved, and erected. Still ahead were the tasks of lifting the obelisk out of the quarry, finishing the surfaces to a near-perfect flatness, and sinking along the length of the four sides the deep, three-dimensional reliefs. Needless to say, the chasm appears to be widening between Engelbach's theoretical optimistic ancient Egyptian results and the historical timeline of the obelisk's creation.

Engelbach allows only 30 inches of extra depth for the quarrymen to work on the undercut, in contrast with 40 inches for the unfinished obelisk. Even then, he is using material removal rates that he assumed the ancient Egyptians achieved and which far exceeded his own results, which researchers that followed have been unable to qualify. I would agree that the ancient Egyptians could remove a greater amount of material in an hour than he could, but not using the tools that he proposed. The idea that stone balls were used to quarry granite obelisks, or any other granite artifact, not only has not been proved, but also the evidence to support the notion falls apart under scrutiny.

An additional difficulty not adequately addressed by either Engelbach or Lehner is that turning the work of bashing vertically onto the granite surface with a dolerite ball and working horizontally—working, in effect, without gravity's help—is far more difficult, dangerous and less efficient than working *with* gravity on a horizontal surface.

If we were to half the removal rate that Engelbach used to calculate the undercutting, we would still be performing the task more efficiently than Stocks or Lehner, who were applying force vertically. Such a claim that half the amount of material may be removed per hour when cutting underneath the obelisk as compared to the rate when cutting vertically alongside is not supportable, and to imagine the ancient Egyptians hammering away at the wall face with stone balls, stone axes, or any other kind of stone implements, and removing eleven times more adamantine granite an hour than Stocks removed is similarly unfounded.

There is a tendency to romanticize the abilities of the ancient Egyptians because they produced structures that were miraculous for their time and certainly would pose a serious challenge to ours. They were somehow immensely more talented with sticks and stones than modern researchers have been able to demonstrate using the same implements. When pondering the theories proffered by Egyptologists, one gets the impression that an ancient Egyptian quarry worker was like a maestro playing a complete symphony on a violin made of a cigar box and a stick and producing the quality of a Stradivarius.

The argument is pleasing and poetic, but the trouble is that, metaphorically speaking, when modern scholars make a violin from a cigar box and a stick, its results are precisely what you would expect from a cigar box and a stick. So the question persists: From what instruments did the symphonic architecture in ancient Egypt materialize?

For a manufacturer or a technologist, the subject is more cut and dried, and it resides in real-world engineering. The material removal rates of tools are known, and if a tool is capable of removing only a certain amount of material under certain conditions, the only efficiencies to be gained are organizational efficiencies in reducing the time spent to support the use of the tool. Estimating engineers do not take the material removal rate of a tool and quote a job that assumes a 63 percent increased removal rate. They will calculate the material removal rate and add time to their quotation for ancillary tasks that support its use. In the case of the standard Egyptian obelisk, the ancillary tasks are the removal of waste, taking breaks for drinking and eating, tending to

injuries, and periodically exchanging workers. To do otherwise would drive a company into bankruptcy. An engineer or construction superintendent would not look at the demands imposed by a granite obelisk on a worker with a dolerite pounder with any degree of optimism.

Yet we are still faced with a nagging question: if the ancient Egyptians did not use dolerite pounders, then what did they use? I have pondered this question both on site and during the intervening years. I believe we have to look closer at the quarry marks and ask ourselves if these are truly the marks left by a dolerite ball. For instance, in plate 18, we can see a long view of the trench with Dan Hamilton standing inside one of the test shafts. Figure 9.16, figure 9.17, and plate 18 pose questions that dolerite pounders do not answer.

What these photographs show is that the tool that cut the trench

Figure 9.16. Vertical cuts with horizontal striation down the north side of the obelisk

Figure 9.17. Test shaft with sharp inside corner near base of obelisk

left horizontal marks that are familiar to machinists and are consistent either with a tool that is drawn out of a hole and then reinserted to begin cutting again or with a tool that cuts while performing a horizontal sweeping motion, or both. Down the entire length of each scallop on the wall of the bedrock and the obelisk, we can see clearly these horizontal striations, and most of them are in line with each other (see figure 9.16). Other features that argue against the dolerite pounder theory are sharp inside corners in the test shafts as seen in figure 9.17 as well as the undercut area seen in plate 18, which are evident in the upper and lower left photographs. These sharp corners are clearly not the result of a 6-inch round ball.

Considering the implied efficiency in quarrying and delivering Hatshepsut's obelisk in seven months, the use of more advanced tools must be introduced into the equation. With what has been proposed so far, the job would quite simply not be done in time. In examining the

trench around the Unfinished Obelisk and especially the test shafts, which plunge through the granite up to 19 feet from the top of the obelisk, the introduction of mega-machinery does not seem out of place—except that there have been no machines found in the archaeological record.

A thorny question is now on the table: with dolerite pounders making their way back to the scrap heap where they belong, what kind of tools did the ancient Egyptians use to quarry their obelisks? The horizontal striations are typical in cutting when the feed of a tool that is removing material pauses along its path, withdrawn to remove waste, and the interruption of the tool leaves a mark on the surface. Also, it could be that as the tool was rocked back and forth against the walls of the trench to clear the waste on the vertical wall, horizontal striations appeared where the tool pressed the cutting surface against the side wall to keep the trench from narrowing.

The tool marks on the trench are most certainly not precision machining. However, machining may provide a clue in explaining the features found on this mysterious ancient work site. With this in mind, I provided a drawing to Don Reed, the supervisor of the tool room at Danville Metal Stamping, and asked him if he could machine some holes in a piece of aluminum—or any other suitable material. I provided him with a drawing of the hole placement (see figure 9.18) and asked that the tool be a ball end mill (depicted in figure 4.4 on p. 97 and figure 6.17 on p. 160). I didn't expect that the result would be identical to the marks left on the Unfinished Obelisk, as I was asking a skilled toolmaker to execute the work, being aware that when quarrying rock the toolmaker has no control over how his or her tools are being used or abused.

The results were presented to me by an excellent toolmaker, Doug Carter, and were what I expected of the geometry suggested in figure 9.18. Figure 9.19 illustrates the results, but indicates that more than likely the ancient Egyptians did not use a tool that rotated horizontally. The ball end mill certainly left radial impressions on the bottom of the cut as expected, but they are not the same as those at the bottom of the obelisk's channel. More than likely, the obelisk channel

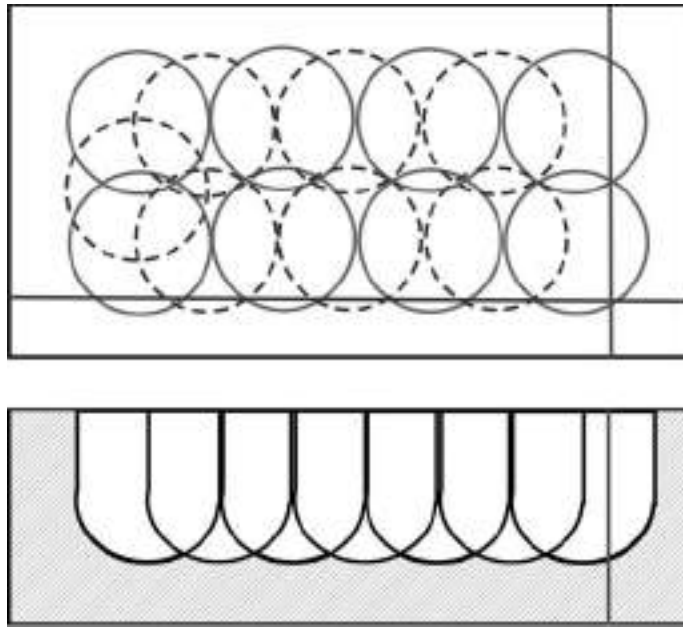


Figure 9.18. Drawing of drilling requirement in aluminum

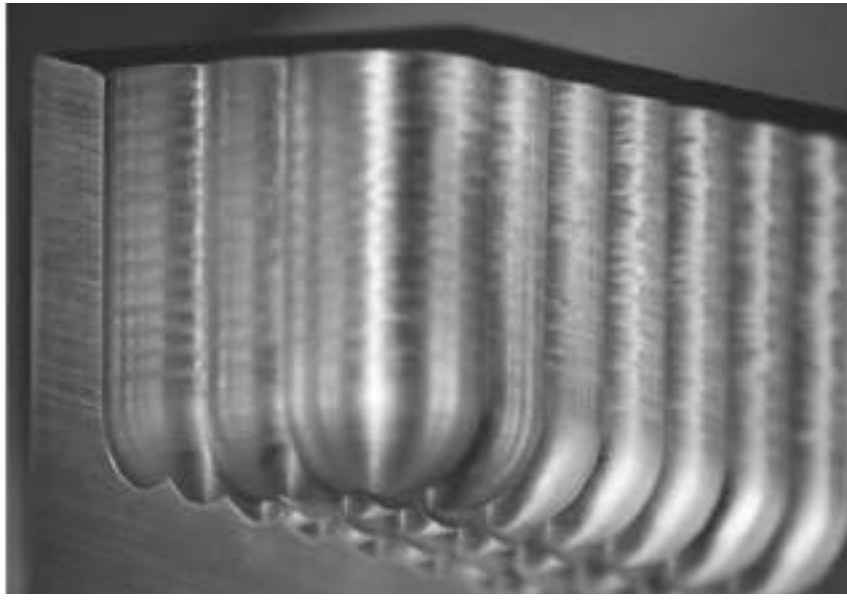


Figure 9.19. Tool marks with periodic horizontal striations

was cut using a tool that functioned similar to a chain saw, except it was much wider as the intention was to remove as much material as possible in an efficient manner. An idea of what such a machine might look like is seen in figure 9.20. Also, the horizontal striations on the aluminum were as expected, as these always appear when a tool is plunged into the material and is then removed for cleaning out waste, then reinserted in the hole to continue cutting.

However, there are indications that the machinery that plowed out the material around the obelisk was more versatile than the one shown in figure 9.20 and could actually cut around corners. Figure 9.21 provides evidence of undercutting that was made near the obelisk. Needless to say, this image fully discharges the dolerite ball theory and suggests either a more versatile machine than that depicted in figure 9.20, or another type of machine designed specifically for this kind of operation.

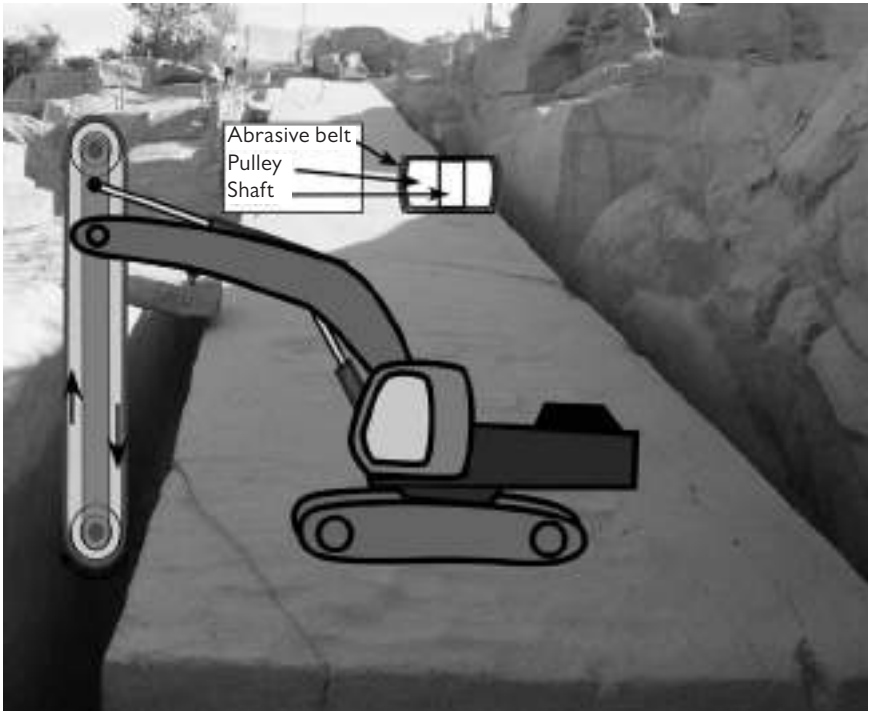


Figure 9.20. Theoretical equipment for trenching around the obelisk

Figure 9.21. Undercut near the unfinished obelisk (Courtesy of Patrice Pooyard)

There should be no doubt by now that the ancient Egyptians were exceedingly brilliant in their conception and execution of large-scale projects. But what powered the tool and how it was applied against the rock are questions that lead us to the real world of the ancient temple, statue, and obelisk builders. This was a world that engaged in engineering on a massive scale and building a civilization for millennia. Surely such a grand vision that allowed the ancient Egyptians to think in these terms also requires us to grant them the intelligence to have developed tools that are of a similar scale in their grandeur.

To suggest, however, that the ancient Egyptians used megamachines in prehistory is stretching the evidence to limits that are unacceptable to historians and Egyptologists. There have been no megamachines from the ancient past found in Egypt. Similarly, there have been no megamachines from prehistory found in Rome or Greece, though writings

about them exist and theories about what they might have looked like have been tested.

Is it too much of a leap to go from dolerite pounders to machines, without any intermediate technologies such as iron tools? If we consider everything found in Egypt in an engineering context and look at other evidence of megamachines in action, a picture emerges that provides momentum to make that leap. From the Unfinished Obelisk we are going to travel to the outskirts of Cairo to a site that is off the well-beaten tourist path. We are going to Abu Roash, the site of an unusual pyramid and a mysterious piece of granite that provides more clues to the immensity of scale upon which the ancient Egyptians applied their genius.

10
In the Shadow of Egyptian Megamachines

Heaven wheels above you, displaying to you her eternal glories, and still your eyes are on the ground.

Dante Alighieri[1]

Immense in size and enigmatic in their design, the pyramids and temples of Egypt are a perennial source of speculation and wonder. They have challenged the minds of generations of engineers and scientists, who marvel at their construction and complexity of design.

In my discussions with fellow engineers over the years, there has been no disagreement that what was created in ancient Egypt is sophisticated in a way that would severely stretch even modern capabilities. In fact, when they visit Egypt, modern engineers, with modern tools and technology at their disposal, gape in awe at what the ancient Egyptians accomplished. Where are the answers to our questions about how such stonework was created? A prehistoric culture was empowered with a vision and genius to design and build pyramids and temples that are miracles of precisely tooled stone on a gargantuan scale. Surely they would not limit their genius to conceiving only the final product. It seems that such genius could influence the design and building of tools capable of producing works of such majesty.

Figure 10.1. View of the Giza Pyramids from the pyramid at Abu Roash

Academic historians may argue that modern engineers are overly influenced by their machines, thus all the Egyptians' works are interpreted through the prism of modern technology and there is little respect for the abilities and talents of the ancient Egyptians who, they believe, made do with simple tools. For their part, engineers argue that the ancient Egyptian toolbox accepted by scholars has no tools in it that are capable of producing what is found in Egypt, and that to advance our understanding of that time in prehistory, we must assign sensible and workable tools and methods that can physically demonstrate the capability to create such work. Experimental trials have already demonstrated the inadequacy of conventional understanding of technology used.

The artifact discussed in this chapter presents a challenge to modern engineers, for it cannot be produced using any of the methods proposed by conventional theorists. I first heard of the area where this artifact is located during a lecture by independent Egyptologist Stephen

Mehler, a passionate and enjoyable companion and presenter who brings almost forty years of research, both in the field and in the library, to his unique perspective on Egyptian history. More than any person I have met, Mehler respects the abilities of the ancient Egyptians, and he honors the ancient Egyptians and an Egyptian elder named Hakim (now deceased, may he rest in peace) in his books: *The Land of Osiris* and *From Light into Darkness: The Evolution of Religion in Ancient Egypt*.[2, 3] In November 2004, we both shared our perspectives and findings during a conference and tour of Egypt. I was particularly intrigued by a part of Mehler's presentation that addressed the pyramid at Abu Roash (also spelled Abu Roashh, Abu Rowash, and Abū Ruwaysh). The site was not on the regular tourist venue, and even though it was only five miles away from the Mena House, where the presentation was given, I had no time left to visit the site. Besides, I did not expect to find incredible stonework there, because, from the photographs Stephen showed, there was not much left of the pyramid, and no sarcophagi, statues, or building blocks caught my eye. There are some researchers who argue that the pyramid was completely finished before being ravaged by forces of nature, and then was plundered by humans, but others believe that the pyramid was never finished—which I am inclined to believe. Its unfinished state was probably due to the same forces that halted the quarrying of the Unfinished Obelisk and brought the ancient civilization to a screeching halt.

The pyramid at Abu Roash is credited to Khufu's son, Djedefra, who chose a site five miles away from his father's pyramid—but for what reason? There are only speculations. Perhaps he was the black sheep of the family and had a greater ego than Khufu, so he wanted to be buried at a higher elevation. Who knows? Nonetheless, Mehler makes a cogent observation in his book *The Land of Osiris*.

> The only evidence linking Djedefra to Abu Roash were the remains of a king's head carved in dark purple quartzite found in some rubble near the site. A cartouche found with the head had the title Djedefra, so it was then assumed this was an individual who had

> the pyramid constructed for his tomb. Egyptologists state the style of the structure is a throwback to the 3rd Dynasty pyramids and is quite inferior compared to the Great Pyramid. The pyramid was built on a small hill and would only have been 190 feet tall if it had been completed, and is estimated to have been 348 feet to a side. When compared to the Great Pyramid which is 484 feet high (with capstone added, 454 feet high as it stands today) and 755 feet to a side, this pyramid would appear minuscule. Why would the son, having become king and with the same resource, material and manpower available to him as his father, have chosen to build such an inferior monument to himself?[4]

Two of three quartzite heads found during an excavation at the site in the early 1900s are in the Louvre Museum in Paris, and the third is in the Egyptian Museum in Cairo. All of the heads were assigned to Djedefra.

In 2006, I had the opportunity to visit Abu Roash after the Magical Egypt Tour with John Anthony West. Instead of traveling home after the tour, I checked into the Mövenpick Hotel to meet up with David Childress, Jennifer Childress, and Steve Zagata, who were visiting Cairo at the time. They were also intrigued by Abu Roash, and because David was the publisher of Stephen Mehler's book, he was aware of the site through Stephen's writings. On February 21, 2006, we hired a taxi and headed north on the Alexandria road to a mysterious place I had never visited before but was going to see merely out of curiosity, without any expectations of finding anything of significance.

After traveling a few miles along the road to Alexandria, our driver's Peugeot veered suddenly off the road and darted through a gap in a fence. This was not quite what I was expecting, but I hung onto my hat as the driver gunned the engine and the car started a rough and meandering climb up a hill with no sign of anything to indicate that this was a well-traveled road. Our driver had a talent for dodging the boulders that occasionally appeared on the path, and he had an air of confidence about him that indicated he had been here many times before.

As the taxi climbed the hill, we became level with a Ghaffir's hut

that was perched on the hillside. Running from the direction of the shack was a man wearing a galabeya and a smile. He approached the car and chatted with the taxi driver who told us that he was the guard for the site and would be expecting some baksheesh when we left. That seemed reasonable, so we went on and finally arrived at the summit to the north of what appeared to be a rough collection of blocks that resembled a mastaba. Surrounding the truncated and partially built—or partially destroyed—pyramid was a rough stone wall that was similar in construction to the Giza workers' village. The stones were made of very rough blocks that were arranged like crazy paving.

My first impression was that compared to Giza, it was as unimpressive a site as I had seen, and I didn't wonder why it was not on the list of sites that most tourists visit. This may change, however: the place has just recently received a revival of sorts and is being proclaimed "the Lost Pyramid" by Zahi Hawass. In walking around the pyramid, we came to the descending passageway (see figure 10.2), which eventually reaches a level where a large swath of material had been scooped out of the bedrock. Other passages, such as the descending passage in the Great Pyramid as well as the one in Khafre's pyramid at Giza and Sneferu's pyramids at Dahshur and Meidum, also lead to bedrock. The passage in the pyramid at Abu Roash is much wider—approximately 14 feet wider—than what is found in a finished pyramid (the Great Pyramid passageways being only 41 inches). This gives rise to the speculation that it was designed to allow passage of very large blocks that would be used in the construction of the chamber below where enough finished limestone to provide dimensions similar to those of other pyramids would be installed. The pit is open to the sky, so it could also be argued that the masonry could have been lowered from the top when the downward passage was completed. These are the conundrums that pyramids evoke—with no satisfying answers for those who may ruminate on them.

After I searched this planned bedrock chamber for significant evidence of stone cutting, I climbed to what served as the top of the pyramid in order to take in the view of the area. I was careful to stay away from the open pit because of the uneven surface, an abundance of loose

Figure 10.2. The descending passageway inside the pyramid at Abu Roash

Figure 10.3. Looking up to the top of the pyramid from the bottom of the pit

Figure 10.4. Starting the climb to the top of the pyramid

Figure 10.5. The pit from the top of the pyramid at Abu Roash

rubble, and trip hazards. Also, from the top of the pyramid is an uninterrupted view of the three major pyramids at Giza, which is always an attention grabber, no matter where you are located within sight. While it is tempting to look around and feast your eyes on your surroundings, in Egypt it is always recommended that you keep your eyes on the ground while walking in elevated places.

When I moved to the east side of the pyramid, I could see below some of the structures that are claimed to be associated with mortuary ceremonies. Unlike those at Giza, these are not constructed of megalithic blocks of stone, such as those in Khafre's temple, the Valley Temple, and the Sphinx Temple at Giza. Instead, they are cobbled together with small, rough blocks that could have been the tailings or chips from a limestone quarry, and they were plastered over with mud brick. It seemed clear to me that these structures were the product of a later culture and not the one that was responsible for building the pyramids at Giza or the one building the pyramid at Abu Roash.

Taking in more of the view, I saw a long gash in the ground running north to south between two rough stone walls, but, more important, an object in the forecourt closer to the pyramid below caught my eye (see plate 19). Though all around the site there are blocks of granite without any semblance of finish, unlike what we found at Giza, this lone block at Abu Roash was very different. As it turns out, it was different in a highly significant way.

A trip to the top of the Abu Roash pyramid is a brief excursion, for there is little to see once you have visited all four sides, and there are only a few steps between them. As I made my way down to the base of the pyramid, I was anxious to examine more closely what appeared from the top to be a finely finished surface on a block of granite—yet this block was unique beyond being the sole finished piece on the site. Upon approaching it, I could see that someone before had also seen some significance in it, because they had raised it up and placed it on rough blocks of stone. This was convenient for me, because it meant I didn't have to stoop as far to see it or wonder how thick the piece was if sand had gathered around it.

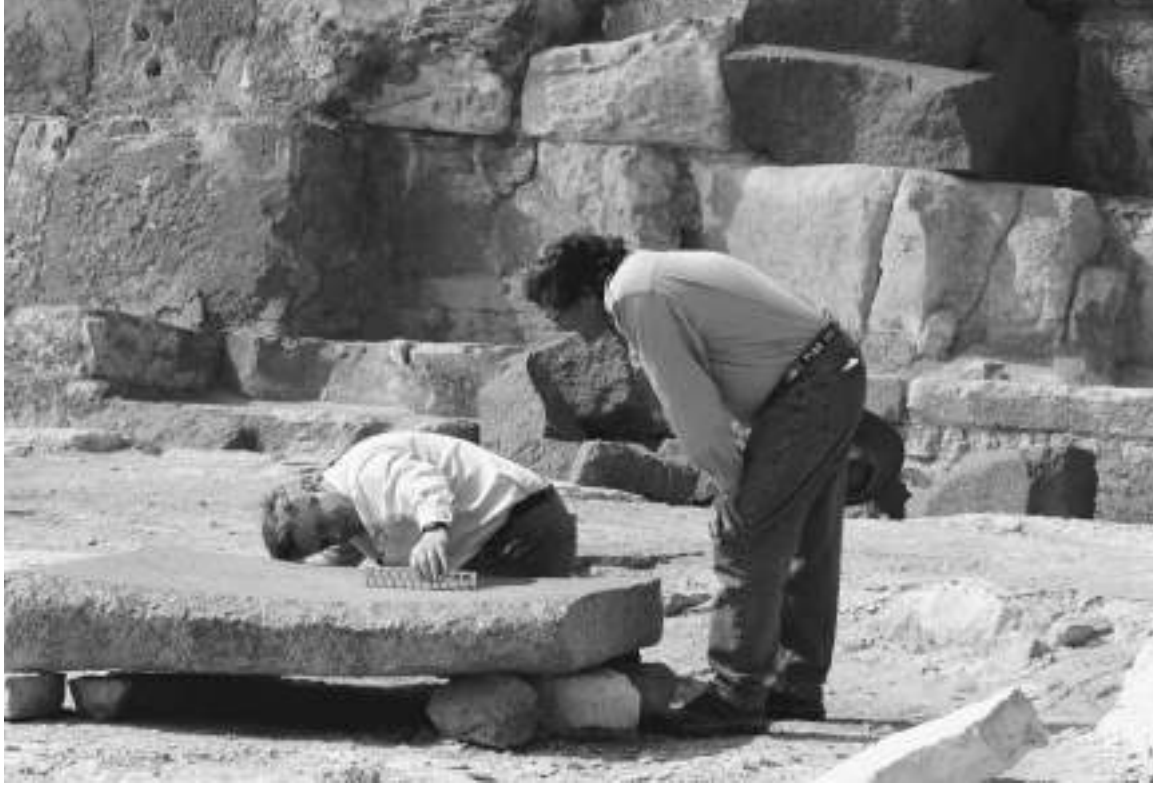


Figure 10.6 Chris Dunn and David Childress examine the granite block at Abu Roash.

Figure 10.7. Concave surface of the granite block at Abu Roash

As it turns out, the finished surface I saw from the top of the pyramid was indeed a very smooth, seemingly machined surface—but it did not have the flatness of other machined blocks of granite I had inspected. The surface was actually concave. It was totally unexpected

to find a machined concave surface on a block of granite. After visiting numerous sites around Egypt, from Saqqara to Aswan, and measuring perfectly flat surfaces on granite artifacts, coming across one with a concave surface (see plate 20) that was fully exposed made me sit up and take notice, because it provided opportunities for examination that were not offered by the curved paving blocks near Khephren's pyramid.

Knowing that someone must have had knowledge of this stone in the past, it was imperative that I find out who may have taken note of these inexplicable features of the granite. I found the following obscure reference that while lacking in detail, may have been addressing this particular stone: "When Petrie investigated he found a curved fragment thought to be from a pink granite sarcophagus in the burial chamber and the French-Swiss team have recently found a copper axe blade which was part of a foundation deposit."[5]

We can see another inexplicable feature of this stone. The smooth concave surface (figure 10.8) ends in another concave radius where this block had evidently broken away from another block. I took some other photographs during my visit this day, but after looking closely at what I had when I arrived home, I realized that I needed better photographs in order to analyze the artifact properly. Nonetheless, the implications of the piece amazed me while at the same time giving me a better understanding of the ancient Egyptians' mastery of their craft than what is conveyed in tomb drawings, such as those shown in figures 10.9 and 10.10.

Nothing on this planet compares to ancient Egyptian stonework. It must be studied in the way that Dr. Peter Lu, of Yale University, studied ancient China. He concluded that the ancient Chinese must have used compound machines three thousand years ago. His research, published in *Science,*[6] is systematic, logical, and hard to refute.

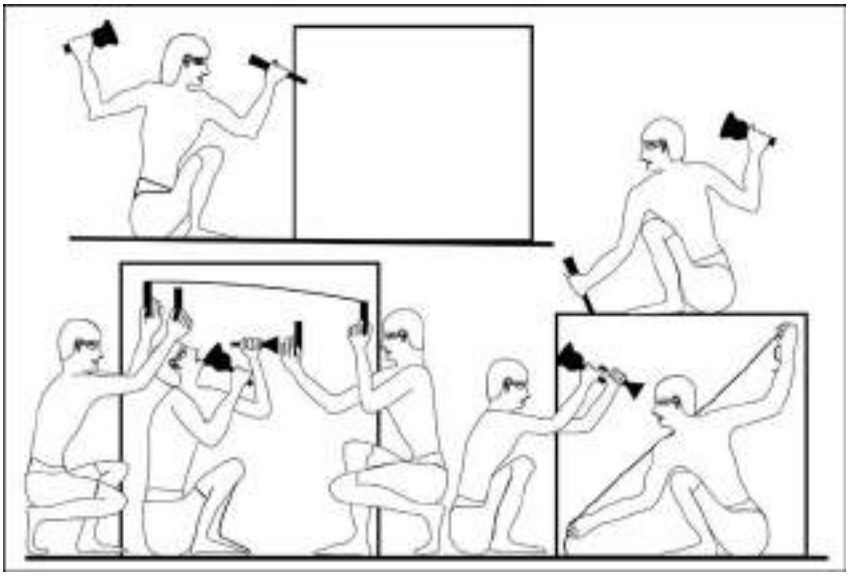
He made this groundbreaking discovery while studying jade burial rings M1:7 from Tomb 1 of the Chu minister at Henan Xichuan Xiasi (552 BCE) that had been carefully inscribed with what appeared to be equally spaced spiral grooves. A simple camera and computer-aided design program were the tools with which Dr. Lu was able to draw his inference. Replication of the spirals was accomplished experimentally

Figure 10.8. Radial features of the granite block at Abu Roash

by a mechanical scribing tool guided by precise linear and rotational motions.

If we apply the same methods as those of Dr. Lu, what would the stone at Abu Roash tell us about its origins and the tools that were employed to make it? After my visit in February 2006, I tried to imagine the kind of tool that created this piece and how it was applied. Because of the radial features, it became clear that only a large circular saw would have been able to create the two radii on this block. The question that nagged me, though, was what was the size of the saw? My photographs were not taken along the same axis as the radius, so any

Figures 10.9 (right) and 10.10 (below). Tomb drawings of Egyptian stoneworkers



dimensions calculated from them would be wrong. A better set of photographs was necessary to accurately calculate the radius. Here again, I was affected by the same tantalizing and passionate need that was similar to how I felt after examining my photographs from Luxor and other sites: I had to gather more data.

Judd Peck and I traveled the same route to Abu Roash on May 4, 2006, that I had traveled in February—though this time with a different taxi driver. The routine, however, was the same: the friendly fellow from the shack came to us, we agreed to baksheesh, and we had the site to ourselves. This time, I packed a good tripod, a right-angle viewer, a remote shutter release, and a more versatile lens. Though I don't claim to be a professional photographer, I listened to their advice, which was to get good optics and electronics. The EOS Canon Digital Rebel was

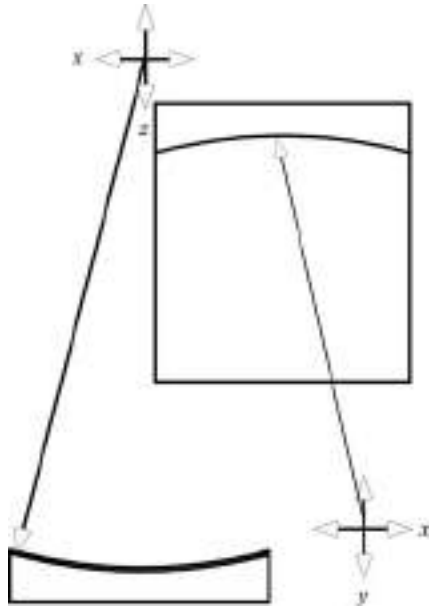


Figure 10.11. Drawing of the Abu Roash stone depicting the *x*, *y*, and *z* axes

not the best camera on the market, but for what I was doing, it was good enough, and better lenses and electronics meant I didn't have to suffer the anomalies of a cheap digital camera.

I set up my tripod on top of the stone, and I was able to get a photograph close enough to the axis of the radius that ended the machined surface (plate 21 B and C), which I have identified as the *z* axis in figure 10.11. Then I took a photograph along the length of the block to get as close as I could to parallel the axis of the surface radius (plate 21 E), which I have identified as the *y* axis in figure 10.11. The concave surface radius rotates around the *y* axis and the concave radius where the cut terminates rotates around the *z* axis. Except for two surface irregularities at 12 inches and 37 inches, as seen in plate 21 B, the surface is true to the segment of a cylinder.

Looking closer at the surface of the block in figure 10.12, we can see striations that are spaced between approximately 0.030 inch (0.762 millimeter) to 0.06 inch (1.52 millimeters) apart. These are a common feature on many artifacts found in Egypt, including some holes and the

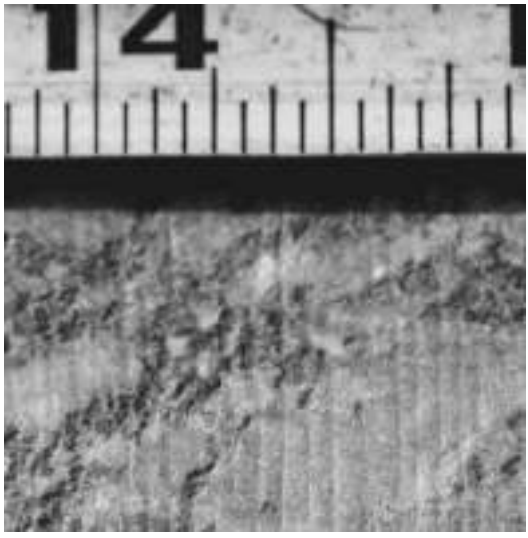


Figure 10.12. Close-up of surface showing saw-cut feed rate

cores that were extracted from the holes. With respect to the tools that created these marks, Petrie describes cutting with saws in his 1883 book, *The Pyramids and Temples of Gizeh,* and he concludes that the ancient Egyptians must have had cutting materials harder than quartz and that the marks were created through the action of a single cutting point:

> We therefore need have no hesitation in allowing that the graving out of lines in hard stones by jewel points, was a well-known art. And when we find on the surfaces of the saw-cuts in diorite, grooves as deep as $^{1}/_{100}$ inch, it appears far more likely that such were produced by fixed jewel points in the saw, than by any fortuitous rubbing about of a loose powder. And when, further, it is seen that these deep grooves are almost always regular and uniform in depth and equidistant, their production by the successive cuts of the jewel teeth of a saw appears to be beyond question. The best examples of equidistance are the specimens of basalt No. 4 (Pl. viii.), and of diorite No. 12; [see figure 10.13] in these the fluctuations are no more than such as always occur in the use of a saw by hand-power, whether worked in wood or in soft stone.[7]

The straight saws varied from .03 to 0.2 inch thick, according to the work; the largest were 8 feet or more in length, as the cuts run lengthways on the Great Pyramid coffer, which is 7 feet 6 in. long. The examples of saw cuts figured in Pl. xiv. [see figure 10.13] are as follow [sic]. No. 1, from the end of the Great Pyramid coffer of granite, showing where the saw cut was run too deep into the stuff twice over, and backed out again. No. 2, a piece of syenite, picked up at Memphis; showing cuts on four faces of it, and the breadth of the saw by a cut across the top of it. This probably was a waste piece from cutting out a statue in the rough. No. 3, a piece of basalt, showing a saw cut run askew, and abandoned, with the sawing dust and

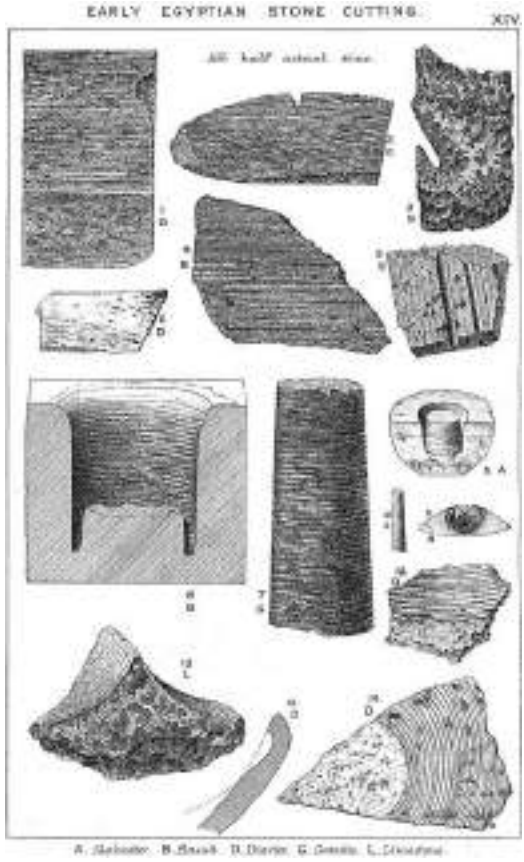


Figure 10.13. Plate xiii from *The Pyramids and Temples of Gizeh*

> sand left in it; a fragment from the sawing of the great basalt pavement on the East of the Great Pyramid. No. 4, another piece from the same pavement, showing regular and well-defined lines. No. 5, a slice of basalt from the same place, sawn on both sides, and nearly sawn in two. No. 6, a slice of diorite bearing equidistant and regular grooves of circular arcs, parallel to one another; these grooves have been nearly polished out by crossed grinding, but still are visible. The only feasible explanation of this piece is that it was produced by a *circular saw* [author's italicized emphasis]. The main examples of sawing at Gizeh are the blocks of the great basalt pavement, and the coffers of the Great, Second, and Third Pyramids, the latter, unhappily, now lost.[8]

Because most of the literature discussing the sawing of blocks is centered on the Giza Plateau, we will leave Abu Roash for a while and travel to Giza to examine the basalt pavement to the east of the Great Pyramid that Petrie had examined. Taking an overall view of the pavement, we can see that many of the tool marks would not even be noticed if we were not looking for them or were not familiar with these types of surfaces. In fact, an afternoon spent studying the pavement will confirm the fact that most tourists who visit the pyramids pass it by without even a second look. The majority of the surfaces on the top and side are rough—presumed by some theorists to have been dressed with a hammer. The bottoms were not important to the builders, for they set the blocks like tiles in gypsum mortar, and we can see the rough contours of the underside of the paving blocks embedded in this material.

I had been able to take many photographs of this pavement, and while Petrie discusses three examples from the basalt pavement in his book, there are more than a dozen blocks in this pavement with all manner of saw marks. Some appear to be straight and others are curved, similar to those on the block at Abu Roash. The saw marks appear distinct and vary in pitch very little with each striation, for the most part, following a uniform path from one end to the other.

As we can see on figure 10.15 A, the width of the saw cuts on

Figure 10.14. The basalt pavement east of the Great Pyramid

the basalt pavement are approximately 0.23 inch (6 millimeters). The striations in figure 10.15 B (seen with the northeast side of the Great Pyramid in the background) and C give photographic evidence of those that Petrie discussed in his book. Other blocks have more unusual features, and there is no easy conclusion as to how they were created. For instance, in figure 10.16, we see evidence of saw marks that appear to be radial, judging by the termination of the cut.

It appears that the piece was cut in two stages. As we can see in figures 10.16 A and B, there is a regular long cut across the piece with the evidence of a step where either the saw was moved or the piece moved—it is impossible to tell which as either scenario could cause this effect. Toward the end of the right side of the piece, however, it appears that a circular saw cut farther down from where the long cut (area L) would normally have ended, and figure 10.16 C shows the striations gradually changing their angle until the termination point is met—that termination point appearing to be a concave radius (area M). Yet figure 10.16 B does not indicate a radius at the termination point, and we might conclude that a view of the piece on an angle that sees a straight cut only on a curved face would produce this geometry. When we look down on the piece in figure 10.16 A, however—albeit this is not quite a vertical

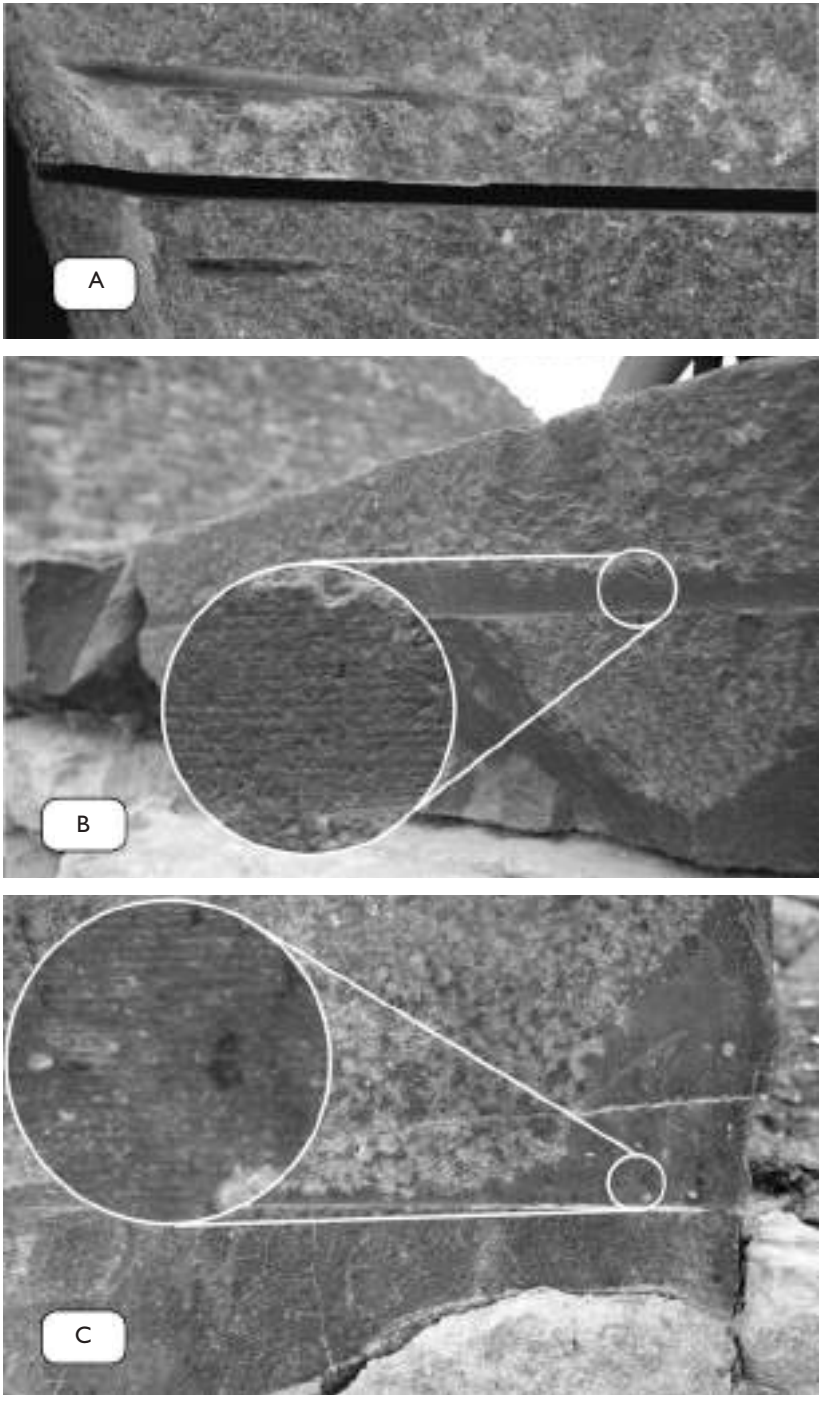


Figure 10.15. Collection of photographs from the basalt pavement near the Great Pyramid

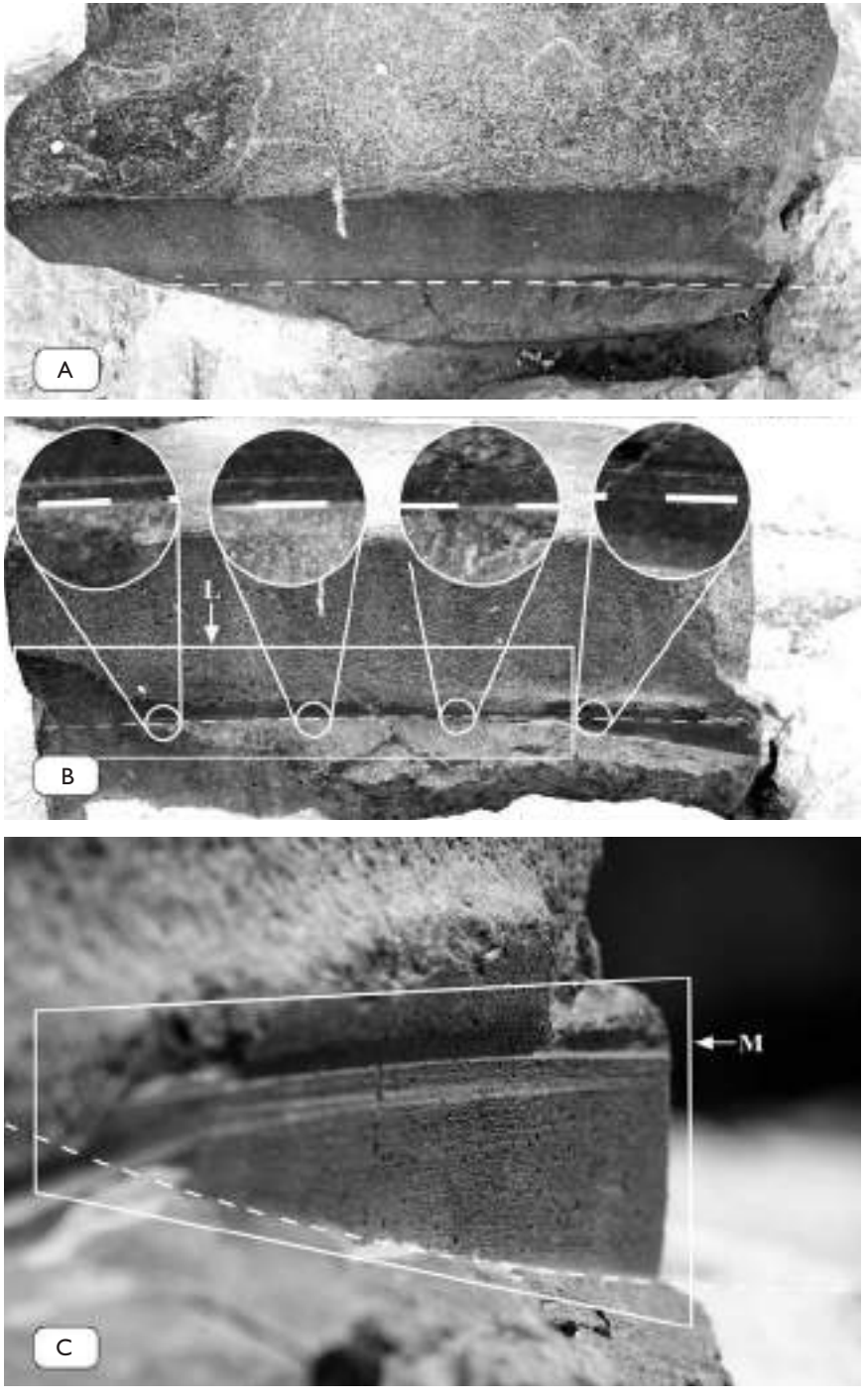


Figure 10.16. Three images of the same basalt pavement block east of the Great Pyramid

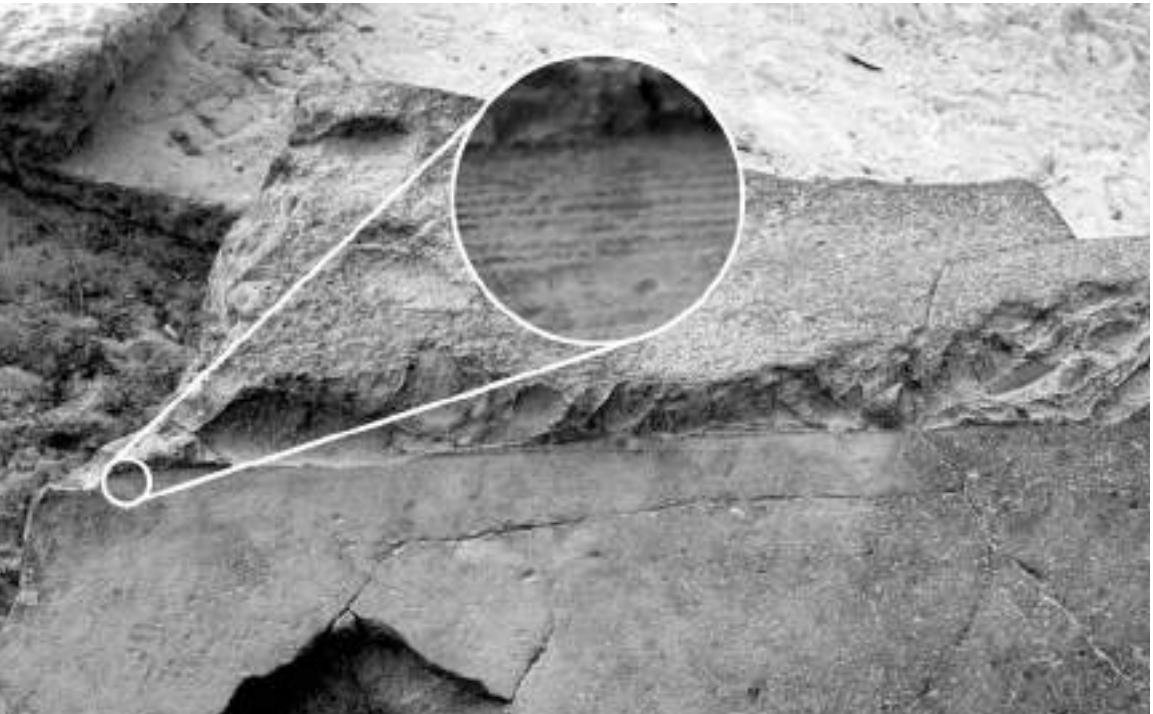
perspective—the curve of the face does not appear significant enough to create such an effect.

Notwithstanding the appearance of a radial cut, the use of circular saws when cutting these basalt blocks is dismissed by Robert G. Moores Jr. In an article titled "Evidence for Use of a Stone-Cutting Drag Saw by the Fourth Dynasty Egyptians," Moores writes, "The cut grooves could not have been produced by a rotating blade such as found on a circular saw. A rotating blade does not make scratches of variable radius. Even if the blade was four meters in diameter we would expect to see a pattern of circular scratches across the cut face of two meters radius, but this is not the case."[9]

Moores describes the striations on blocks of basalt as having ". . . essentially-parallel grooves up to a half millimeter [.02 inch] deep, spaced about one to two millimeters [0.039–0.078 inch] apart. In cross section the grooved face would approximate a sine curve, with the valleys being slightly narrower than the lands between."[10]

There are numerous examples of plunge cuts, where a saw left a slot

Figure 10.17. Striated block of basalt on the Giza Plateau



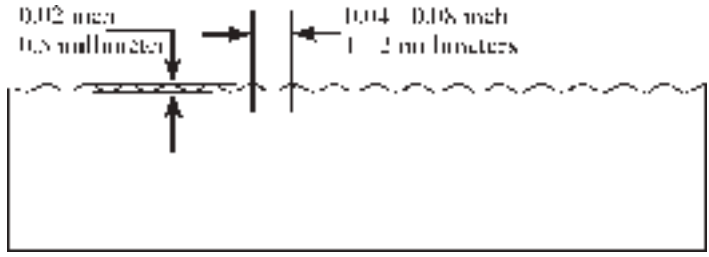


Figure 10.18. The sine curve addressed by Moores

in the basalt. Figure 10.16 and figure 10.20 show these types of cuts. The example Moores gives in his article shows the same cut but on a different block. On a block he identifies as block A, he measured the width of the cut where the saw ended and reported it to be 0.118 inch (3 millimeters; see figure 10.21). He notes: "In cross section, the kerf, i.e., narrow slot that the blade makes while cutting, has, by eye, a perfectly radiused bottom, about three millimeters wide, that tapers outward with an included angle of about eight degrees, (fig. 6.) [see figure 10.21]. The kerf sides are very smooth—not striated."[11] Moores's observations regarding the perfect radius and smooth sides are important to remember as we discuss his proposed methods of manufacture.

Without going back in time and talking to the pyramid builder, it is impossible to explain every anomalous action that created the complex variety of evidence on the basalt pavement. Considering that the now-exposed blocks that reveal these saw cuts were originally covered by adjacent blocks, it is not unreasonable to speculate that the sawed parts of the blocks were given a quick shave in order to remove irregularities that were inherent in the quarrying process and were holding one block apart from its neighbor. If we consider the overall roughness of the blocks, this quick shave was more than likely given by the only tools available on the site, and they were the tools used for finishing and cutting to size all of the blocks that went into building the pyramid. It is well known that these blocks are extremely precise in their cutting, especially those that make up the walls of the inner chambers and also the casing blocks—assuming they were all of the same exactness as the

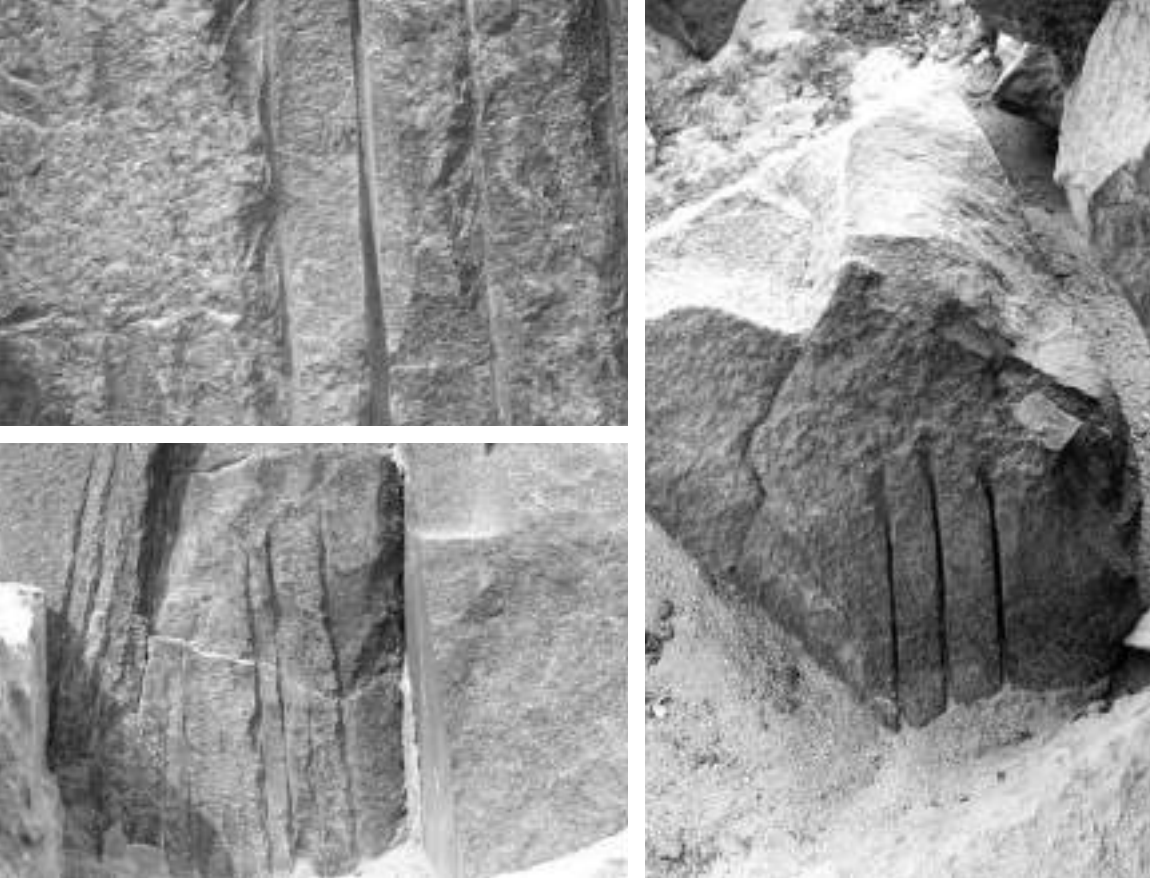


Figure 10.19. Slots sawed into basalt blocks

Figure 10.20. Sawed basalt (identified as block A by Moores)

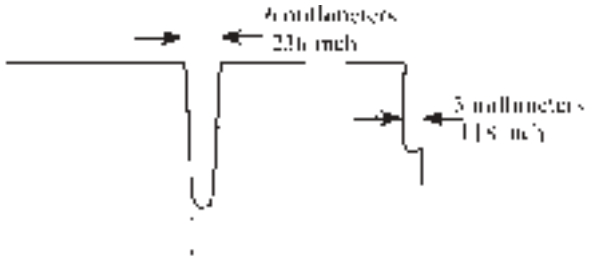


Figure 10.21. Cross section of slot. Drawing by C. Dunn after Moores's figure 6.[12]

few that survive. It could be argued, therefore, that the roughing tools were not on the plateau, but were applied elsewhere.

The quick shave proposed by Moores involved the use of a drag saw. The device, Moores admits, ". . . [i]s somewhat more advanced than general views of the pyramid builders' technology level now held."[13] In this respect, Moores pushed the envelope of Egyptological thinking. But did he go far enough? Figure 10.22 shows Moores's concept of how the marks on the basalt were made.

Moores proposes a blade made of copper with a notched leading edge. The blade was 157 inches (4 meters) long and 23.6 inches (60 centimeters) broad and was wedge-shaped from 0.393 inch (1 centimeter) at the top to 0.118 inch (3 millimeters) at the cutting edge. Moores estimates the weight of the blade was 308 pounds (140 kilograms). Quartz

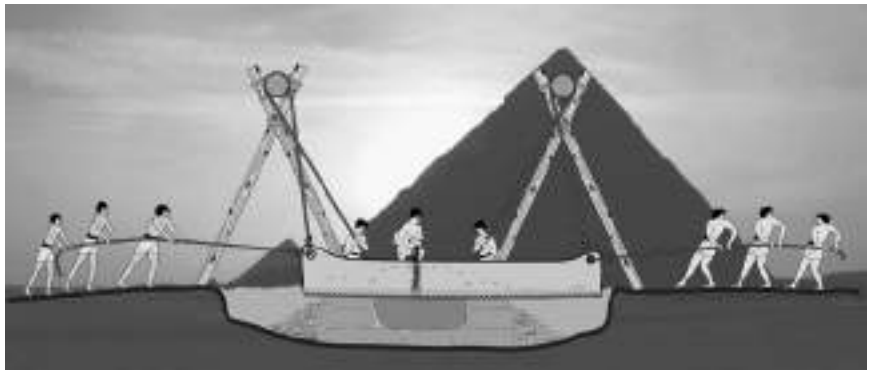


Figure 10.22. Moores's concept of the pyramid builders' drag saw. Drawing by C. Dunn after Moores's figure 11.[14]

sand was used in the process as an abrasive. It was rubbed against the basalt both as a loose medium and also, by quartz sand that was embedded into the copper. This process, with fresh sand being added to the cut as used sand and sawed rock was flushed away, impressed the shape of the blade into the basalt.

As we see in figure 10.22, a team of workers dragged a blade across a block that was fixed inside a trench filled with water. The blade was suspended on ropes that were controlled by workers, who, according to Moores, managed the blade's incremental descent into the basalt.

Using the cadence of a 78.7-inch (2-meter) pendulum, Moores calculates that the blade swung from one side to the other in approximately 2.84 seconds. Using the distance between the striations of 0.039 inch (1 millimeter), Moores then calculates that in one cycle, (two strokes, one in each direction) the saw plowed into the basalt 0.078 inch (2 millimeters). Using the physics of the pendulum, he then calculates that in one minute, the saw could have cut through 1.653 inches (42 millimeters) of basalt.[15]

These are extremely positive outcomes and do not seem to satisfy all questions that could be raised about the practicality of Moores's solution. It is hard to imagine the successful employment of the physics of a pendulum on a swinging 308-pound object that ultimately is met with a hard, solid surface covered in sand. It is also hard to imagine a 308-pound blade slicing through basalt at a rate of 1.653 inches (42 millimeters) per minute. If we take into consideration the fact that the blade is wedge-shaped, which would mean its increasing width would impede its progress into the slot, the impossibility of the operation becomes more evident.

Fortunately, information has been published on experiments using saw blades made of copper plus quartz sand to cut granite. These experiments were carried out by Denys Stocks in March 1999 at a quarry in Aswan using a 32-pound (14.5-kilogram) copper saw blade that was 5.9 feet (1.8 meters) long, 5.9 inches (15 centimeters) deep, and 0.236 inch (6 millimeters) thick. The blade was weighted down with four stones on each end, for approximately 99.2 pounds (45 kilograms). Stocks provides

sawing rates that are significantly less than those calculated by Moores. Using wet sand, Stocks was able to cut a 2.46-foot (75-centimeter) slot in granite to a depth of 3.149 inches (8 centimeters) in 30 hours. This calculates to 0.105 inch (0.267 centimeters) per hour cutting rate and a volume of stone removal that is 360 cubic centimeters (a rate of 12 cubic centimeters per hour). Stocks experimented using dry sand, and he cut a 3.117-foot (95-centimeter) slot to a depth of 1.181 inches (3 centimeters) in 14 hours, which calculates to 0.084 inch (0.214 centimeter) per hour, and a stone removal weight of 170 cubic centimeters or 12 cubic centimeters per hour.[16] He reports the total weight of copper used to achieve these results as 459 grams in 14 hours, which would be 33 grams in one hour.

Stocks's experiments show that a hand-powered saw advanced into the granite more slowly over a long cut than a short cut, but the rate of material removal was almost the same. If we apply Stocks's data to determine how long it would take to saw the six sides of the granite box in Khafre's pyramid, it would take approximately 6,270 hours[17] (see box on p. 272 for details). The total hours given are conservative estimates and do not take into account additional widening of the saw-cut, which Stocks measured to be 2.5 *cent*imeters at the top and 6 *mill*imeters at the bottom (emphasis added by author for clarity).[18]

It is impossible to reconcile Stocks's experimental results with Moores's hypothetical results using a drag saw. In pondering the results of Moores's proposed sawing rate of 1.653 inches (42 millimeters) per minute (2,520 millimeters per hour) compared to Stocks's experimental sawing rate of 2.14 millimeters per hour, we should take into account how modern saws perform when cutting granite. United States Patent 7082939, filed in 2003, describes an improved frame saw using carbon alloy steel blades with replaceable segments that are impregnated with diamonds. The patent cites a down-feed rate in granite of 30 millimeters per hour.[19]

These modern rates are 14 times greater than those achieved by Stocks, which is not surprising, but 84 times *less* than Moores's proposed rates. Considering the operating conditions, Stocks's rates make

COMPUTATION OF APPROXIMATE HOURS TO SAW GRANITE BOX IN KHAFRE'S PYRAMID

Basic Measurements

Stocks's length of saw-cut	95
Stocks's depth of saw-cut	3
Square centimeters	285
Hours worked	14
Square centimeters per hour*	20.36

*Added by author

Granite Box in Khafre's Pyramid*

Top + Bottom	East + West	North + South
Box length, 263.35	Box length, 263.35	Box width, 106.4
Box width, 106.4	Box height, 96.82	Box height, 96.82
Square centimeters, 28,020.44	Square centimeters, 25,498.81	Square centimeters, 10,302.16
Total, 56,040.88	Total, 50,997.62	Total, 20,604.32

*Dimensions given by Petrie converted to centimeters by author.

Totals

Total square centimeters of Khafre's box	127,642.8
Stocks's square centimeters	20.36
Total hours for box	**6,270.22**

sense, while Moores's hypothetical sawing rates once again seem impossible using the equipment he proposes. However, Moores does point out that his results are the maximum achievable using the cadence of a pendulum and recognizes that the hardness of the rock and friction could slow the process down. The capabilities of modern saws prove that Moores is correct in this one statement, which occupies the space of only one sentence in his article.[20]

Before we return to Abu Roash, we must resolve the difference between Petrie's observations and Moores's with respect to the use of circular saws. The evidence Moores was looking at would certainly point to the use of straight saws. Yet there are other blocks on the pavement that pose a problem to the notion of the exclusive use of straight saws.

As we survey the area of the pavement, we see the marks of ancient tools that will appear to change geometry as our point of view changes. To understand what is happening, we can look at figure 10.23, which gives three examples of saw cuts on two different types of surfaces. Block A has a straight cut on a flat surface. This kind of cut will always look straight, regardless of any variation in the viewing angle. Block B has a curved cut on a flat surface. The radius of the curve will appear to shorten as the block is rotated down, or lengthen if the block is rotated up. Block C has a straight cut on a curved surface. We see that the straight cut of C-1 is curved in the z axis, looking perpendicular from the top (y axis), but a radius of varying size is seen depending on the viewing angle, see C-2 and C-3. Views from the side will also exhibit varying sizes of radii. If we use the radius of C and create a full circle, then the views seen in C-2 and C-3 are actually sections of an ellipse. An ellipse in a unique manufacturing process will be discussed further when we return to the granite stone at Abu Roash.

While the apparent curvature of the block seen in figure 10.16

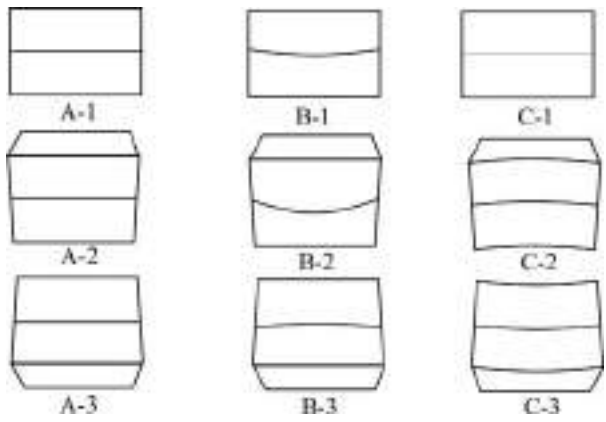


Figure 10.23. The geometry of a flat and radial saw cut on a flat or radial surface

(p. 265) is too ambiguous to provide a solid conclusion, another block lies a short distance away from the pavement and would go unnoticed by the casual traveler unless he or she stumbled over it. That block can't be explained by the use of straight saws, because the surface is curved in a way that would eliminate the random arching of a blade or any amount of uncontrolled meandering by a shaky operator.

Figure 10.24 contains three views of this basalt block that when viewed from the side at an angle, the saw cut seen in figure 10.24 A ends with a radius. Without examining the block further, it could be argued that a hand-operated straight saw created the cut, and that the operators of the saw did not keep the saw straight as it moved through the cut, but instead allowed it to drift up and down. This is a common occurrence and, in fact, achieving a perfectly straight cut with a hand-powered saw is almost impossible. Fully impossible is the achievement of a concave radius for the obvious reason that it is physically impossible to create a saw cut where the entrance and exit points are higher than the middle with a flat-edged straight saw. Some may argue that the saw could bend and create this condition, and indeed they are more than welcome to prove their claim. Stocks did not observe this condition during his experiments and neither have I during my experience working with handsaws that were thinner than Stocks's.

If we look at figure 10.24 B, which is a view of the front of the cut surface, the striations are clear, but the radius where the cut ends is larger from this angle. The reason for this is explained in figure 10.24 C, in which we are looking at the surface from the top. It is clear from this angle that the entire surface is curved. It is possible, therefore, that the geometry of this block is the same as the example shown in figure 10.23 C-1, C-2, and C-3, in which a surface was cut on a radius and the tool that cut the radius left a step that was straight when viewed straight on, though it appeared curved if viewed on an angle, such as when viewed from two angles, to the side and from above, such as the view in figure 10.24 A. The radius appears smaller than B and C, which indicates that the cut surface is curved and not flat. Along with Petrie's testimony to the use of circular saws at Giza, what we can gain from

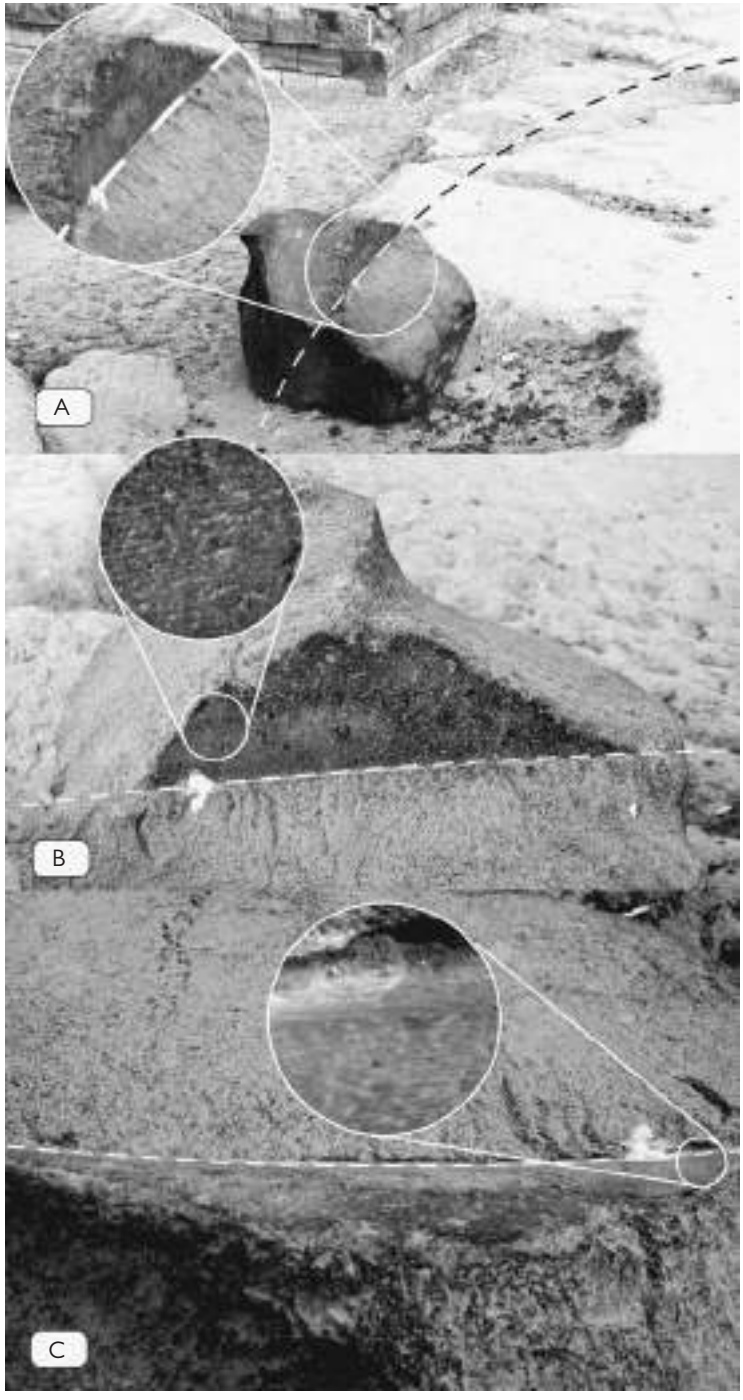


Figure 10.24. Evidence of circular cutting tools on the Giza Plateau

this block is further evidence that efficient circular tools were used on the Giza Plateau, though we are still left to wonder about what they looked like, how they were driven, and from what material they were made.

As discussed earlier, Moores's observation of the root of one of the saw cuts he examined (see figures 10.19, 10.20, and 10.21 on pages 268 and 269) describes the bottom of the saw cut as being a perfect and smooth radius. Of his experiment in sawing granite at Aswan, however, Stocks notes that, "[a]s before, similar parallel striations were visible on the sides and the bottom of the slot."[21] This seems to be in conflict with the evidence noted by Moores on the Giza Plateau. Unfortunately, we have nothing to compare how similar Stocks's striations are with ancient saw cuts because in his article, Stocks does not provide a thorough comparative analysis with photographic proofs.

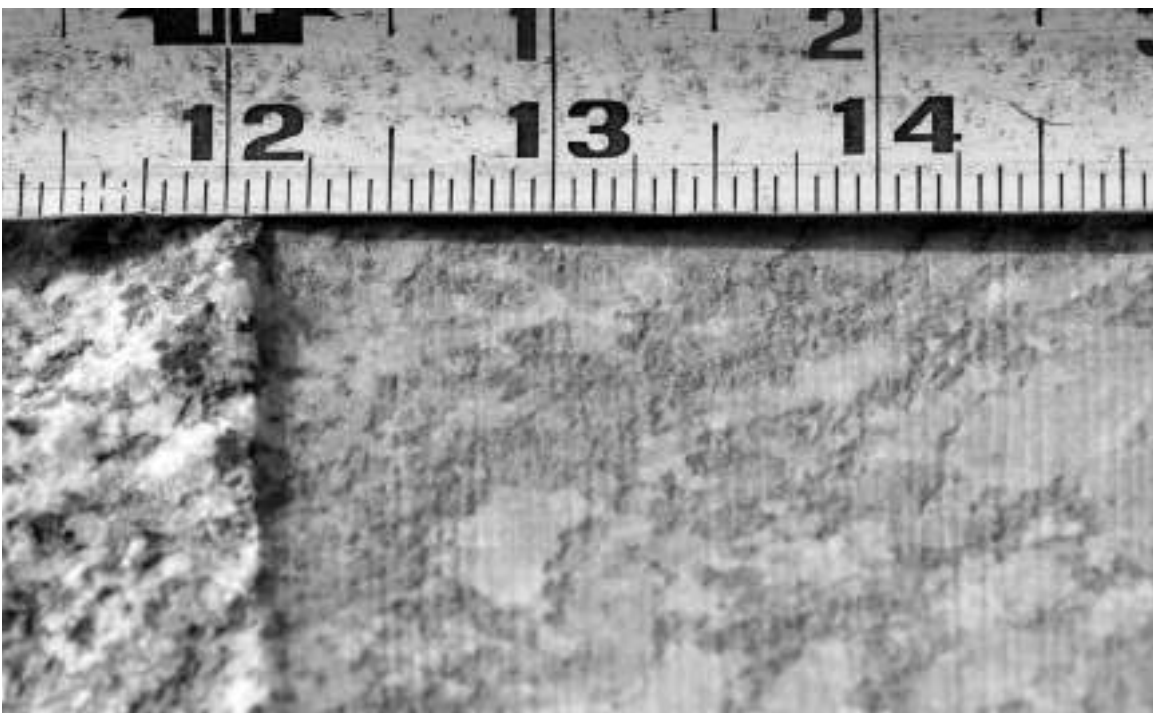
The Giza Plateau provides further evidence for the use of circular saws, but first the stone at Abu Roash demands more attention: though the marks on the basalt blocks at Giza indicate the use of circular saws, the striations left on them are different from those on the granite block at Abu Roash. Though the ones at Giza appear to follow straight or curved lines, the striations on the stone at Abu Roash drift from side to side from similar theoretical lines. As seen in figure 10.25, the striations wander slightly from a true straight or curved path, but, inexplicably, each of the striations wanders in the same direction as its neighbor and follows a parallel path. This does not support the view that abrasive slurry was at work to create these marks. It seems to be powerful evidence that fixed cutting points that are set into a rotating cutting tool were acting on the surface. Why, then, were the lines wandering from a true path? A possible explanation for these striations is that there was some wobble in the saw as it moved across the granite. Yet other characteristics of the piece seem to pose more questions.

The radius where the cut surface terminates is puzzling when we consider different ways in which the block may have been made. Often in the dark early hours of the morning, I came up with numerous methods for cutting this piece, but each of them failed to provide a practical solution. One suggestion made to me was that the blade that cut the

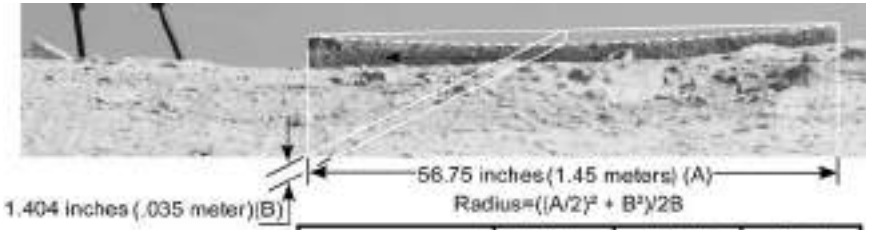
piece was a straight saw but that it was warped and cut the curve on the stone face. If that were possible, it would explain one radius on the block, but whether you view the block from above, or along its length, you see a radius. When considering this and pondering on how this inexplicable geometry was cut into the granite, the straight saw has to be eliminated, because it would be impossible for it to cut a concave radius along its face and along its edge. Another suggestion given to me was that the stone was cut by a stone ball swinging from a pivot point. Yet the evidence suggests a far greater amount of control and certainty than that of a swinging ball—regardless of the skill put into the swing.

I tried to imagine a process in which the piece would be cut in one single sawing operation, but I could not come up with a method that did not demand more out of the tool than was possible due to an increase in surface area being cut. In other words, assuming a larger block was being cut along the striated surface with the saw on an angle, depending on the thickness of the entire block, the thin block, which is the one we are studying, would break apart from the thicker one. But passing the stone across the saw on an angle would result in an increase in

Figure 10.25. Striations on the stone at Abu Roash

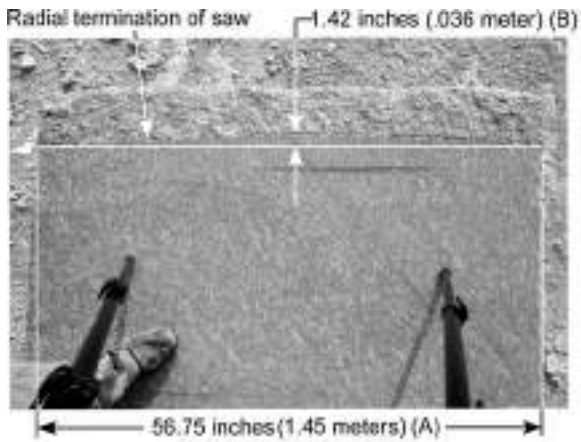


the surface area being cut. In pursuing an answer to the puzzle, while providing an answer to Petrie's question about the size of the saw, it was necessary to calculate the radius of the saw and the granite block at Abu Roash, provided the attributes to calculate the radius, with, perhaps, a tolerance of 5 percent of the diameter. To achieve this, it was necessary to use both radii swung around the *y* and *z* axes referenced in figure 10.11 on page 259 (see figures 10.26 and 10.27).



	Inches	Meters	Feet
Chord Length (A)	56.75	1.441	4.729
Arc Height (B)	1.404	0.035	0.117
Radius	287.43	7.300	23.95
Diameter	574.86	14.6	47.905

Figure 10.26. Calculating the *y* axis radius.



	Inches	Meters	Feet
Chord Length (A)	56.75	1.44	4.729
Arc Height (B)	1.42	0.036	0.118
Radius	284.21	7.218	23.684
Diameter	568.42	14.437	47.368

Figure 10.27. Calculating the *z* axis radius

Three points were selected along the arcs in both figures 10.26 and 10.27 to create circles. Zooming in on the arc, it was determined that the radius in figure 10.27 (which defines where the cut ended) is accurate over approximately 93 percent of the arc. As seen in figures 10.26 and 10.27, using the dimensions of the chord (56.75 inches (1.441 meters) and the sagitta, or arc height—1.404 inches (0.035 meter)—in the *y* axis, and the dimensions of the chord and the arc height—1.42 inches (0.036 meter)—in the *z* axis. The radius of the arc is 23.95 feet (7.3 meters) in the *y* axis and is 23.684 feet (7.218 meters) in the *z* axis.

It should be noted that the sagitta of the *y* axis radius was taken on the end of the block nearest the camera and that the radius may not be the same where the surface meets the end of the cut where the stone is broken off. Taking all of this into account, the figures given here are the result of measurements taken under specific conditions. I make no assertion that they are perfect measurements and that they are not subject to change if the stone is examined under laboratory conditions. I recognize, also, that others may take their own photographs and achieve different results, or may achieve different results from my photographs.* The two and three decimal point callouts do not imply two and three decimal point precision. Yet I do assert that they both indicate, with close agreement, that the saw that cut this block had a very large diameter.

Our view of the calculated arcs along their theoretical axes does not reveal the saw's true diameter. It assumes that the centers of these radii were located perpendicular to the camera's axis, whereas the cut surface being studied had a concave radius cut along its length. These conditions suggest that the saw that cut both radii must have been on an angle or that the granite block was pushed into the saw at an angle. By

*An article published in *Atlantis Rising* magazine entitled *The Mega Saws of the Pyramid Builders* (Issue 70, July/August 2008, Doug Kenyon, editor) contained a different photograph that was taken in 2007. After returning to Abu Roash in November 2008, I was able to take another photograph from a lower point. This photograph, used here, resulted in a different radius and, therefore, a different diameter saw. It should be noted, however, that the difference between the two is within 5 percent of their respective diameters. Also changed here is the formula to correct the tilt angle, which was published in AR 70 as (cutter diameter / radius2 = Sin of angle of tilt) and is corrected here to read (cutter diameter / radius2 = radian measure), from which the sine of the tilt angle can be obtained.

knowing the dimensions of both radii, therefore, we can make a more accurate calculation of the saw diameter.

When viewed at right angles, the radius cut at an angle into the stones is seen as a segment of an ellipse. A useful trick in machining is to tilt a cutter on an angle to machine a larger radius into a work piece. The rules are that the block has to be much narrower than the cutter in order to avoid creating more of an elliptical shape. The formula, that is usually found secreted in a toolmaker's toolbox under or inside a copy of *Machinery's Handbook,* is given as the *cutter diameter/diameter of desired radius = radian measure*. The following table was created by adjusting the cutter diameter until the radius from the top view and the radius from the end view produced an angle that combined added to approximately 90 degrees. A difference of 0.6 degrees is noted and expected, considering the lack of a precise laboratory inspection of the block.

In calculating the diameter of the saw, I used an Excel spreadsheet and input the known radii, seen from the top and the end, then adjusted the diameter of the cutter until both angles equaled 90 degrees:

CALCULATIONS OF THE DIAMETER OF THE SAW

	Top View		End View	
	Feet	Meters	Feet	Meters
Cutter diameter	37.5	11.43	37.5	11.43
Radius measured	23.684	7.22	23.95	7.30
Radian measured	0.792		0.782	
Angle	45.4		44.8	

This was tested in a milling machine on a micarta plastic 1/61 scale model, the results of which were compared to the photograph of the granite (see plate 22). The process involved tilting a cutter on a 45-degree angle and cutting along the *x* axis (identified as the *y* axis in figure 10.11, p. 259) until I had reached a point where I could break off the material at the cutting edge. The piece that broke away from the

block had all the characteristics of a pyramid casing stone, but the angle was not consistent with Egyptologists' speculation on the angle of the pyramid. Lehner, though unsure of the exact angle, proposes a range of 48 to 52 degrees.[22] Considering the slope of the pavement, however (see figure 10.4, p. 253), a block with a 45-degree angle would be tilted in the opposite direction of Lehner's hypothetical angles, which means that we cannot use this block as evidence of the angle of the nearby pyramid. Whether this granite block is the piece of sarcophagus that Petrie had noted is also uncertain at this juncture.

It seems fairly certain that the block at Abu Roash was not cut with the saw tilted on an angle, but with the block rotated at 45 degrees and moved into the saw, perpendicular to the saw's axis of rotation. To cut the block by pushing it at an angle against the face of the saw not only would apply significant lateral forces, but also it would be inefficient, because the volume of material to be removed would be increased tremendously. Without going back in time and witnessing how this block was cut, we can only speculate, but having thought long and hard about a possible method that would remove the least amount of material and provide the features evident on the block, it involves cutting the block in three operations as seen in figure 10.28.

The small step seen 4 inches away from the radial break on the granite indicates that the block may have been moved through the saw in three stages. If this was the case, then it is possible that two blocks with the same 45-degree angle were created, and then the angle was recut on each to the pyramid angle.

The operation seen in figure 10.28, stage A, created the compound arc and broke off what appears to be a block with the pyramid angle (shaded area). Stage B cut parallel to the bottom of the block and produced another triangular block, which may have also been used as a pyramid block. These blocks are nowhere in the vicinity at the site and must have been carried off with many other blocks. These cuts left a thinner block, which is the focus of our study. At this point, the block would have had a flat face with a step down to the radial break (see figure 10.28 B and E). Then again, for unknown reasons, it appears that the builders

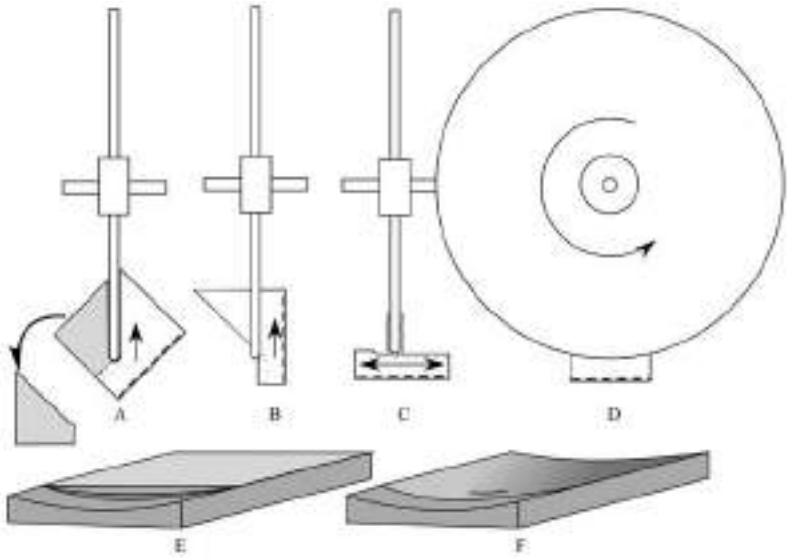


Figure 10.28. Proposed stages of cutting the block

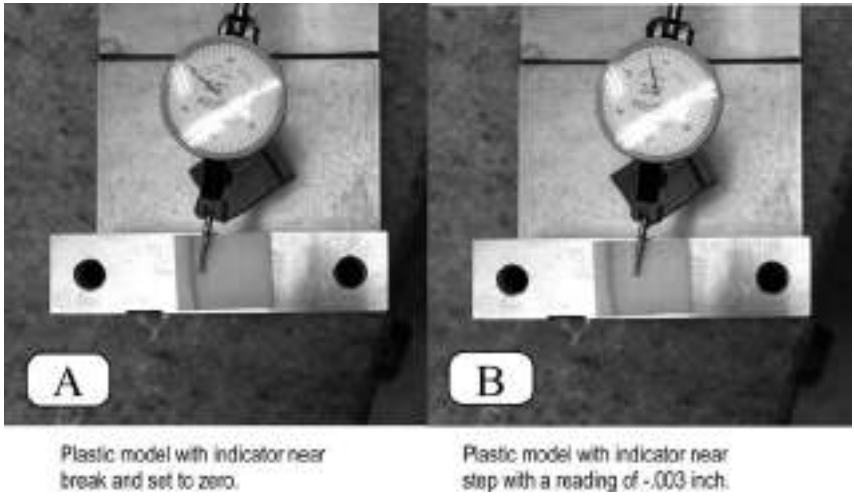

A
B
Plastic model with indicator near break and set to zero.
Plastic model with indicator near step with a reading of -.003 inch.

Figure 10.29. Machined model with step

decided to make the surface even across the length and passed the piece across the saw, where at two points there was movement in the block, and steps in the surface were left (see figure 10.28 C and F).

This theory was tested on a piece of plastic, and a predictable step was created where the cutter was used perpendicular to the surface rather

than at an angle and, therefore, cut a smaller radius. When the full width of the block was reached, the cutter was passed along the entire surface and then the step was measured to be 0.003 inch at its deepest part using an Interapid indicator (see figure 10.29). Across a block the size of the stone at Abu Roash, the step would have measured 0.183 inch deep. Without an exact measurement of the step in the Abu Roash block, I would estimate that it was no more than 0.25 inch. Figure 10.30 provides a close-up of the area showing the parallel striations.

It seems bordering on the impossible to imagine such an operation being performed by ancient Egyptians, but what other method would create each of the following?

1. A compound radius
2. Parallel striations that follow an uneven path across the stone
3. A step about 4 inches away from the break

Figure 10.30. Stone at Abu Roash with machined step

The wobble of the striations provides support for the proposed method, for it would be very likely that a saw blade that is approximately 37 feet in diameter would have some lateral movement, even with small inaccuracies in the bearing—unless there are stabilizing bearings that apply support on both sides toward the outer rim. The evidence in the stone shows clearly that a tool with fixed cutting points was passed across the surface with a reasonable degree of regularity, given the distance between the striations—but seen from one end to the other, there is lateral movement in the striations, which indicates a wobble in the tool.

Because the machines that cut the Chinese jade burial rings and the Egyptian granite blocks are no longer in existence, the evidence is considered circumstantial. Yet it provides us with a fairly accurate picture of at least their diameter, if not quite how they were driven or the materials used in manufacturing the saw.

As we consider the megasaw at Abu Roash, it might be useful to consider machines with similar dimensions that are in use today. Between 1987 and 1994, megamachines that were thought of as marvels of modern technology chewed through 31.6 miles (51 kilometers) of chalk marl beneath the English Channel at a rate of 482 feet (150 meters) per week. Hardened steel and carbide bits at predetermined placements around the cutting face of a Tunnel Boring Machine (TBM) traveled around an 84-foot circumference, creating a tunnel that was 27 feet (8.2 meters) in diameter. These were monster machines designed for a mammoth project in which size truly mattered.

With the new evidence gained from Abu Roash, we now know that when the ancient Egyptians tackled mammoth projects, size also mattered. The evidence shows that when it came to designing equipment that was up to the job of pyramid building, nobody did it better than the ancient Egyptians. While the TBMs that bored through the English Channel were 27 feet (8.2 meters) in diameter, objective evidence shows that the ancient Egyptians used megasaws for cutting granite, limestone, and basalt that exceeded that diameter. We can calculate the size of these saws by the impression they left on the granite block seen in plate 21.

We should not be surprised that a culture able to conceive and build the largest and most impressive structures on the planet did not limit their efforts to just the constructions, but also to the tools they used to build them. The ancient Egyptians created an abundance of evidence from which methods of manufacture can be inferred.

As this evidence drove me to grapple with these concepts, I was stunned by their implications, and I tried to imagine what such a saw would look like, how it was installed on the Abu Roash Plateau, and how the stone to be cut was secured and moved through the blade. The radius on the stone indicated that it was cut slightly off the center line of the saw, which meant that the block was secured to a table that must have been 15–16 feet (4.57–4.87 meters) from the ground. It seems a bit extreme to have to haul blocks of stone 15 feet in the air to be able to cut them, but then it finally dawned on me that there are other features at Abu Roash and at Giza that may provide an answer to this mystery.

Close to where this stone is located and cut into the bedrock there is a deep trench that is 121.39 feet (37 meters) long and 31.5 feet (9.5 meters) deep (see figure 10.31). Similar trenches can be seen on the Giza Plateau on the east side of the Great Pyramid. These long trenches have been labeled *boat pits* by Egyptologists because of their shape, and they are considered to be the symbolic transport of the dead king into the afterlife. Considering the appearance of solar boats in Egyptian art, particularly the prolific reliefs inside the Temple of Denderah and the discovery of a boat in a rectangular pit south of the Great Pyramid, the association of the pits with boats is understandable. The trench at Abu Roash, however, is quite narrow and deep and does not accurately represent the shape of a boat's hull. In addition, no remains of boats were found in these trenches—unlike the rectangular trench south of the Great Pyramid, where, in 1954, an ancient Egyptian boat was found in pieces. The boat was reconstructed, and it is now housed in a museum built specifically for its display. Within an engineering context, it would not be far-fetched to propose that the empty trench in the vicinity of Abu Roash was originally used to accommodate the lower part of the saw's massive diameter (see figure 10.32). This, more than likely, will

not be a popular suggestion among Egyptologists, but from an engineering perspective, it makes more sense—considering the work that was required to construct Abu Roash—than installing symbolic items for the use of the pharaoh's soul in the afterlife.

The revolutions per minute of a saw that is 37 feet in diameter would be relatively low. If we consider that a 1-inch-diameter diamond-tipped drill rotates at 900 rpm, the surface speed calculates to 3.1415926 × 900/12 = 235.619 surface feet per minute. In one revolution, a saw that is 37 feet in diameter would travel 116.24 feet, so it would require just 2.03 rpm to achieve 235.619 feet per minute at the cutting edge. Of course, this is based on modern tools—the kind of materials embedded

Figure 10.31. Trench at Abu Roash

Figure 10.32. Abu Roash with a megasaw installed in its trench

in the substrate of the segments of the outer rim of the saw (if they had reached the same logical idea expressed in the aforementioned patent) are a mystery.

After this enlightening visit to Abu Roash, I returned to the Giza Plateau where seven so-called boat pits located at various places around the pyramids have been uncovered. Two of the largest pits—or slots, as they really appear to be—are oriented north to south on the east side of the Great Pyramid (see plate 23 A and B). Others are located between the queen's pyramids (plate 23 C and D). Another rather dilapidated pit with a fence that has fallen down (plate 23 E) is near Khafre's pyramid to the north of the contoured stone discussed in chapter 6 (refer to figures 6.17–6.20, pp. 160–63). Note that the inset in plate 23 D shows a radial undercut on one end of the trench, which is indicative of a circular saw's action.

When we look at the trenches on the Giza Plateau and consider the enormous task of cutting millions of blocks of stone not just for the Great Pyramid, but also for the other pyramids on the site, the use of megasaws that can cut efficiently through granite and limestone to exacting tolerances somehow gives the manufacture of pyramids a different perspective—a perspective that allows a sense of comportment with engineering on an appropriately massive scale, and one that takes into account methods and machines that were equal to the task at hand.

The whole plateau would have been a hive of activity, with quarried stone being moved onto the plateau next to the saws, in line to be cut to shape for placement in the pyramids. At the same time, ancillary workshops would have manufactured cutting segments that were installed on the rims of the saws as others were worn through use.

It is well known that the biggest enemy of the life of a tool is heat. With a given segment of the saw working only for a fraction of the time it takes to rotate 360°, as it is in contact with the piece being cut, the heat generated during the cutting process would dissipate as the saw turned slowly around. It might also have been beneficial to fill the saw pits with water and have the saw pass through the water after cutting in order to cool it and wash away rock dust embedded in the edge. By the time a given segment of the saw had to cut again, it would have lost most of its water and dried off. A totally dry process, however, would be preferable for waste removal.

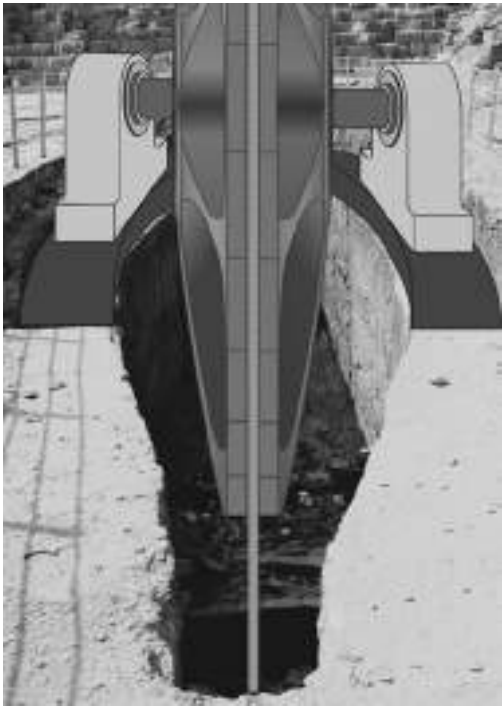


Figure 10.33. Installation of a saw in the trench shown in plates 23 C and D

The removal of waste is a concern. The pits are more than twice as long as their depth, most likely, to allow workers access to remove the waste. One trench on the Giza Plateau has steps descending from one end—an indication that frequent access was necessary.

A discussion of the materials and power available to the ancient Egyptians to manufacture and drive the saws must also consider materials and methods that have not yet been found in the archaeological record. This discussion must take into account not only this chapter, but all the previous chapters of this book.

How many other pits or features near the pyramids may be found lying under the sands of Egypt? As Zahi Hawass has said many times, 70 percent of Egypt's treasures are waiting under the shifting sands for one fortuitous turn of the spade.

The tool marks on the stone at Abu Roash provide evidence for the movement of the tool that cut the granite. Since 1995, tool marks similar to these have been at the center of an ongoing Internet debate concerning a granite core that was taken from a drilled hole and thrown on a prehistoric trash heap at Giza. Sir William Flinders Petrie stumbled onto this piece of granite, took it back to London, and wrote about it in his book *The Pyramids and Temples of Gizeh*. The granite core now resides in the Petrie Museum at the University College, London, along with some other interesting pieces that will shed even more light on the manufacturing capabilities of the ancient Egyptians.

The tool marks left on ancient Egyptian granite tell a story. This story is one of remarkable capability. Resident in academic arguments regarding the efficiency of the ancient Egyptians is that time did not mean the same to the ancient Egyptian artisans as it does to twenty-first century artisans. All of their monuments, we are told, were crafted with simple tools and the time it would take using these simple tools to manufacture all of their monuments and statues. The evidence in the Petrie Museum, however, strongly argues against this notion. The evidence shows that they were using processes that modern manufacturers may yet need to discover. Let's look at that evidence.

11
Walking in the Shadow of William F. Petrie

> *Where is the other evidence of this culture? Show me a potsherd. Show me a tomb. Show me an inscription. Show me any other piece of sculpture that dates from this period.*[1]
>
> Mark Lehner, Egyptologist

Sir William Flinders Matthew Petrie was born in 1853 and died in 1942. In the course of his career, he wrote 102 books and articles appearing in forty-eight journals and six magazines, resulting in 1024 numbered items. His shadow was cast over all who came before him and has influenced those who came later. He is considered to be the father of British Egyptology.

In 1972, Eric P. Uphill created a comprehensive bibliography of Petrie's work. He thanks Ms. Ann Petrie, Sir William's daughter, for allowing him to search her home for rare articles to make his bibliography more complete. His introduction to the bibliography provides insight into how Petrie was viewed by his peers of that time:

> Petrie died during the Second World War so that although his passing was recorded by both learned journals and the press, it did not

Figure 11.1.
Outside the Petrie
Museum in 2003

receive the attention that would undoubtedly have been accorded it in peaceful and less difficult times. Much has been written about Petrie, perhaps the most controversial figure in the whole annals of archaeology, both during his lifetime and afterwards, and probably more eulogies both critical and uncritical have been accorded him than to any other Egyptologist since Champollion. Some have written serious analytical discussions of his work and achievements, or allegedly frank assessments of his faults, yet no one has produced a list of his publications.[2]

Professional disagreement can sometimes turn into heated debate, though such debates may not have been as public in Petrie's day as they are now considering the development of communication technology and how it is used to promote ideas. One of the more widely known debates of the modern era was a contentious disagreement at the American Association for the Advancement of Science Convention in Chicago in 1992 between Egyptologist Dr. Mark Lehner of the Oriental Institute and geologist Dr. Robert Schoch of Boston University. Schoch became involved with ancient Egyptian studies when he was persuaded by John Anthony West to write an opinion on West's claim, after Schwaller de Lubicz, that water weathering on the Great Sphinx, and especially

on the Sphinx enclosure wall, was indicative of a much earlier-than-accepted date for its carving. After performing an on-site analysis, Schoch reported that the Great Sphinx is thousands of years older than scholars generally believe. Lehner called these findings "pseudoscience," and the normal cool politeness of academic debate was thrown on the sacrificial fire as heated voices continued past the time allotted and on into the hallway after the presentation.

Lehner argued: "You don't overthrow Egyptian history based on one phenomenon like a weathering profile" and "that is how pseudoscience is done, not real science."[3]

Schoch, however, held to his evaluation, which was based on the science in which he has been trained—geology—and he reiterated his studies of the Sphinx's erosion. He used sound waves, which suggested that the monuments crevices were carved sometime between 7000 and 5000 BCE.

Scholars of Egyptian history have been scornful of Schoch's science because it is contrary to the research that generations of Egyptologists and archaeologists have developed. Because of his understanding that people from that period were believed to be hunter-gatherers who had not advanced sufficiently to build cities like those of the ancient Egyptians, Lehner asked for evidence of a culture living at that time that was advanced enough to carve the Sphinx. Lehner added, however, that he was willing to consider evidence, such as a potsherd, that would provide a cultural context for this lost civilization.

Dr. Schoch responded that perhaps later civilizations came on to the scene and cleaned up the area.[4] To a layperson and a scientist, this idea does not seem outlandish, considering what we know about how later cultures can absorb and mask previous cultures by destroying or corrupting evidence, as Dr. Andrews pointed out in the foreword to this book. Modern societies, while living and working in the shadows of a previous generation's constructions, create artifacts that are entirely different and may give future archaeologists the wrong idea of what existed here previously should there be a break in the generational transfer of knowledge. Also, when we look at the evidence highlighted in the previous chapters

of this text, this idea does not sound so foreign, and it becomes obvious that more has been lost than we previously believed.

Schoch is also not the first to propose that the ancient Egyptian civilization was older than scholars believe it to be. Lehner himself benefited from followers of the sleeping prophet, Edgar Cayce, whose organization, the Association of Research and Enlightenment, funded his research in Egypt in search of the fabled lost continent of Atlantis—evidence of which was supposed to come to light in 1998. Ultimately, Lehner rejected this outside-the-box view after he failed to find evidence of lost civilizations, and seems to reject the ideas of those who might think that they have succeeded.

The relevance of ancient megalithic construction and precision cutting of igneous rock relies on engineering principles, not on geology or Egyptology. The potsherds Lehner asked to see that would change his mind about ancient Egyptian history are found in Egypt and in museums all over the world. The ones I have studied reside not in Egypt, but are situated in a glass display case in the Petrie Museum in London. The recent documentaries that have been broadcast by Egyptologists have been a distraction from what was really going on in ancient Egypt. They mislead by not addressing the incredible precision of the available artifacts. They do not address the remarkable geometry and exactness of the ancient Egyptians' statues, and they have ignored evidence presented by Flinders Petrie in 1883 that proves that the ancient Egyptians used highly sophisticated methods for cutting stone—including efficient and versatile lathes.

The lathe is a natural development from the potter's wheel depicted in ancient artwork and presumed to have existed in ancient Egypt. The type of potter's wheel in ancient Egypt is taken from an Egyptian relief showing the god Khum seated at what is theorized to be a kick wheel.

From the early origins of potter's wheels, improvements evolved the technology to what we see today, and the spin-off of the potter's wheels that are still in use are found in every manufacturing plant in the world. They have progressed from manually driven machines to water-driven and steam engine–driven line shaft pulleys and belts to the electric

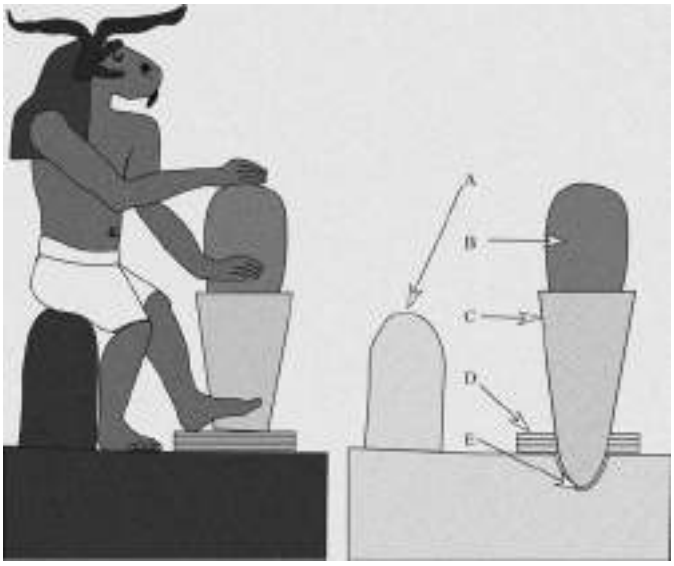


Figure 11.2. Egyptian relief showing the god Khum and a cross section of a potter's wheel assembly: A. Bench B. Work C. Rotating table D. Kick wheel E. Bearing. Drawing by C. Dunn after Hodges.[5]

motor. In 1968, I was employed as a journeyman lathe turner in the tool room at the venerable J and S Eyres Ltd. engineering company in Manchester, England. This was the only company where I worked that had an old-fashioned line shaft driving several machines. Manufacturing and repairing the leather belts for the line was considered a craft in and of itself, with specialists employed to perform such work.

The potsherds in the Petrie Museum, however, are of a different quality than what can be produced on a potter's wheel or even a woodworking lathe of the kind used by undeveloped cultures. What is depicted in figure 11.2 does not explain two potsherds that Petrie describes in *The Pyramids and Temples of Gizeh* and which are called out there as 14 D and 15 D in figure 10.13 (see p. 261):

> The principle of rotating the tool was, for smaller objects, abandoned in favour of rotating the work; and the lathe appears to have been as familiar an instrument in the fourth dynasty, as it is in mod-

> ern workshops. The diorite bowls and vases of the Old Kingdom are frequently met with, and show great technical skill. One piece found at Gizeh, No. 14, shows that the method employed was true turning, and not any process of grinding, since the bowl has been knocked off its centring, recentred imperfectly, and the old turning not quite turned out; thus there are two surfaces belonging to different centrings, and meeting in a cusp. Such an appearance could not be produced by any grinding or rubbing process which pressed on the surface. Another detail is shown by fragment No. 15; here the curves of the bowl are spherical, and must have therefore been cut by a tool sweeping an arc from a fixed centre while the bowl rotated. This centre or hinging of the tool was in the apex of the lathe for the general surface of the bowl, right up to the edge of it; but as a lip was wanted, the centring of the tool was shifted, but with exactly the same radius of its arc, and a fresh cut made to leave a lip to the bowl. That this was certainly not a chance result of hand-work is shown, not only by the exact circularity of the curves, and their equality, but also by the cusp left where they meet. This has not been at all rounded off, as would certainly be the case in hand-work, and it is clear proof of the rigid mechanical method of striking curves.[6]

As seen in the photographs of the bowl shard housed in the Petrie Museum, illustrated in Petrie's drawing is the backside, convex part of a bowl shard (figure 11.3 A). In my article "Advanced Machining in Ancient Egypt?" and in my book, *The Giza Power Plant: Technologies of Ancient Egypt,* with a chapter of the same name, I incorrectly illustrated it as a concave, dish-shaped feature. After visiting the museum and examining the artifact in question, University College London (UCL) ref. UC41398, I am now able to correct this error.

Petrie, however, did not discuss a more important feature of this shard: the concave surface on the opposite side of the surface he had illustrated. This is surprising, because the radial gouge on the dished side of the potsherd (see figure 11.3 B, C, and D) can provide a clue as to what may have caused the bowl to be knocked off axis in the lathe—

or at least another result of the bowl's displacement in the lathe. The questions it raises, however, cannot be answered by conceptualizing the lathes used in ancient time that are depicted in history books. The groove on the "dish" may have been the result of the material shifting on its axis causing the tool to plunge into the material, knocking it off-axis and causing the biaxial, convex radius on the outside of the bowl.

Because it has the impression of the geometry of the tool bit being applied to the surface, the existence of the gouge also proves Petrie's contention that the surfaces noted on his 15 D were created with a single-point tool and were not the result of rubbing with abrasive. This is an important point when we consider the ancient Egyptians' level of technology.

Regarding the use of a single-point tool, Petrie writes:

> That the Egyptians were acquainted with a cutting jewel far harder than quartz, and that they used this jewel as a sharp pointed graver,

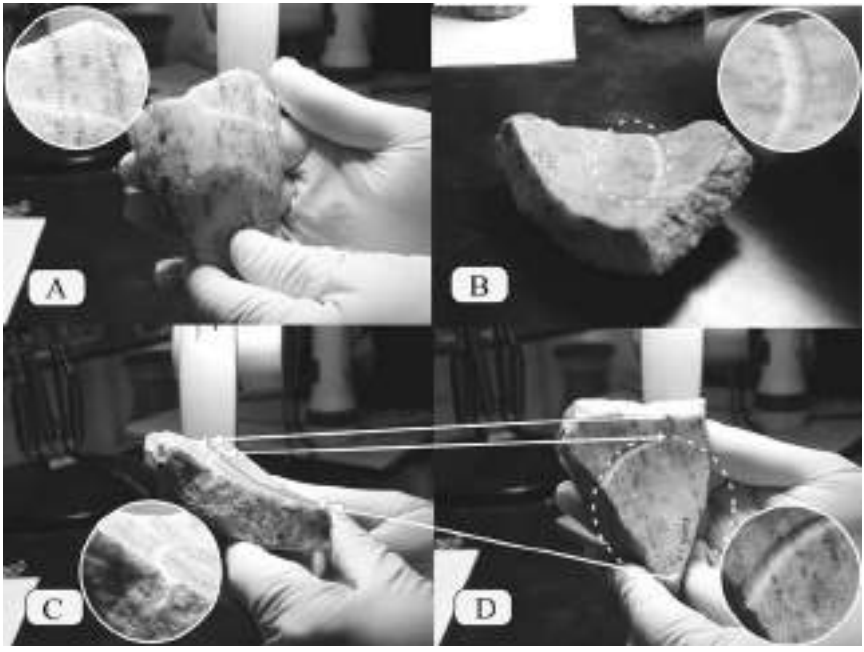


Figure 11.3. Petrie's bowl shard (his 15 D) housed in the Petrie Museum, UC41398, diorite, width 2.7 inches (6.8 centimeters), length 3.8 inches (9.6 centimeters)

> is put beyond doubt by the diorite bowls with inscriptions of the fourth dynasty, of which I found fragments at Gizeh; as well as the scratches on polished granite of Ptolemaic age at San. The hieroglyphs are incised, with a very free-cutting point; they are not scraped nor ground out, but are ploughed through the diorite, with rough edges to the line. As the lines are only 1/150 inch wide (the figures being about .2 [inch]), it is evident that the cutting point must have been harder than quartz; and tough enough not to splinter when so fine an edge was being employed, probably only 1/200 inch wide. Parallel lines are graved only 1/30 inch apart from centre to centre.
>
> We therefore need have no hesitation in allowing that the graving out of lines in hard stones by jewel points, was a well known art. And when we find on the surfaces of the saw-cuts in diorite, grooves as deep as 1/100 inch, it appears far more likely that such were produced by the jewel points in the saw than by any fortuitous rubbing about of a loose powder. And when, further, it is seen that these deep grooves are almost always regular and uniform in depth, and equidistant, their production by the successive cuts of the jewel teeth of a saw appears to be beyond question. The best examples of equidistance are the specimens of basalt No. 4, (Pl. viii), and of diorite No. 12; in these the fluctuations are no more than such as always occur in the use of a saw by hand-power, whether worked in wood or in soft stone.[7]

Implied in the manufacturing errors in UC41398 (figure 11.3) may be the action of two tools at the same time, one on the outside and one on the inside, which indicate that as the tool created the gouge on the inside of the bowl, it pushed the bowl into a component of the chuck that was holding the bowl until the stone broke under the pressure. I make this observation based on the corresponding start points of the inside gouge and the outside undercut. It is difficult to imagine, however, the multiple grooves on the outside of the dish in the sunken area all being created at the same time it took for the inside groove to travel from start depth to finish depth—but then, there are still many mysteries about

ancient Egyptian technology that are not completely understood, and, in this case, without the machines to explain them, we can only speculate.

As we can see on the dished surface, the groove increases in depth until it meets the broken edge. Reference lines have been drawn on the bowl shard indicating the trueness of the radial groove. The arc describing the spherical dish radius that travels from the outside of the bowl to the center was created from three points, as noted in figure 11.3 C and D. This is drawn not to provide dimension to the piece or assert a degree of precision, but as a visual reference and evidence of the curvature.

Perhaps the most important question to ask when we try to determine how these errors were created is: What kind of power was behind the lathe to allow a single-point tool to cut a gouge so deep into the material that the stone would ultimately fail and break? The forces implied with this simple potsherd are not the forces associated with a potter's wheel or a spindle lathe that is spun via the manual push and pull of a strung bow. If a manually operated lathe met such resistance, it would come to a stop. To argue that only manpower was used in the process of creating this error would be to argue that the operator acquired some sort of lever to rotate the chuck that held the stone and made a conscious decision to drive the tool deeper into the diorite and ruin his or her work.

Petrie's 15 D shows the versatility of the lathe employed to create it. As seen in figure 11.4, the surface is double dish shaped with tantalizing telltale shallow striations on the surface. These striations would not be out of place on a modern artifact created on a lathe when a tool, which had made a cut across the surface, was reversed across the same path it took when it made the cut. The grooves shown just below the cusp indicate that as the bowl turned in the lathe, the tool moved rapidly across the surface. Witnesses to this event are the arcs of the grooves not being concentric with the arc of the cusp and the distance between the grooves. In other words, we can clearly see that the shallow grooves do not follow the same arc as the cusp where the radius changes (see figure 11.5) and are somewhat irregular. If the grooves did have the same arc as the cusp, it would mean that the tool was stationary while the bowl rotated. These grooves are also evidence of the use of a single-point tool to machine the bowl.

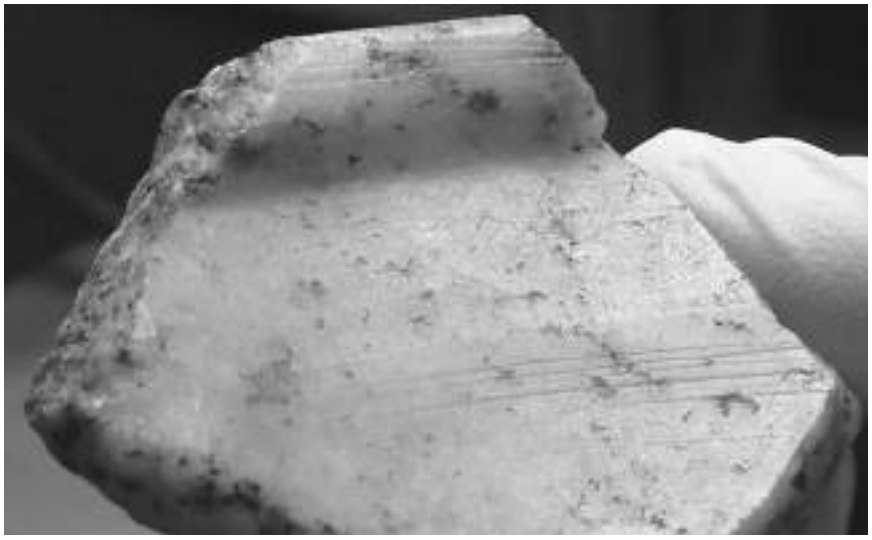


Figure 11.4. Petrie's potsherd (his 15 D), housed in the Petrie Museum, University College London, UC43197, diorite, width 2.5 inches (6.3 centimeters), height 2.3 inches (5.9 centimeters). Note the difference between this piece and figure 11.3: figure 11.4 has a cusp within the dish where two radii intersect and a raised lip around the outside.

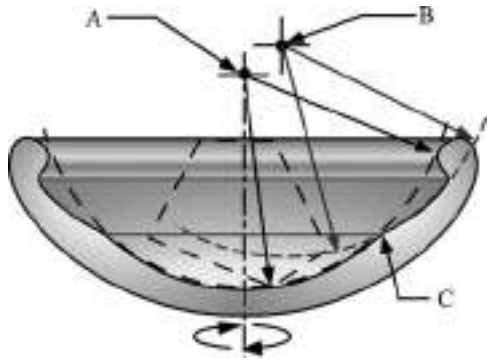


Figure 11.5. Petrie's 15 D with axes of rotation for the sweep of the tool. Point A is the original pivot point of the tool. Point B is the secondary pivot point of the tool and creates the bowl's lip and the cusp (C), where the radii intersect.

When I examined these pieces physically by running a finger across the surface of the dished-out stone, they were smooth, machined surfaces with no dips or high spots. When we take these into consideration

along with the sharp cusp and the scratches in the surface in Petrie's 15 D and the deep groove in his 14 D, the implication is the use of a lathe that was under significant power and that the rotary axis of the bowl and rotation of the tool that cut Petrie's 14 D (see figure 11.3) and the rotary axis of the bowl in Petrie's 15 D (see figures 11.4 and 11.5) were dependent upon precise bearings. This technology pushes the envelope further. It is definitely not discussed in Egyptology books and moves the state of the art of ancient Egypt much higher than where Robert Moores moved it with his drag saw. The use of precise bearings would also be necessary for the proper functioning of megasaws at Abu Roash and at Giza.

Figure 11.6 shows a horizontal lathe that was commonly in use the 1950s through the 1970s. Egyptologists would consider such a lathe beyond the ancient Egyptians' capabilities. Some shops may still have such a lathe on their floor. Progress and inventiveness have seen the lathe evolve tremendously over the last fifty years. Figure 11.7 shows a modern Computer Numerical Control (CNC) vertical lathe. In the span of fifty years, vast improvements have been made to our machines, though we are expected to believe that in ancient Egypt in a span of

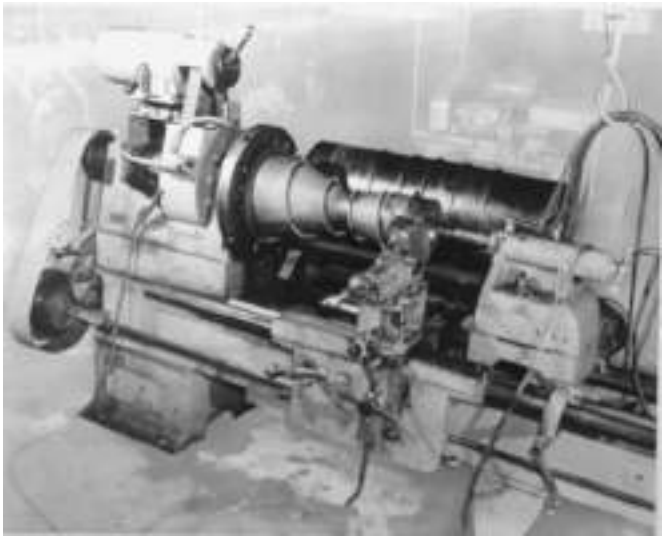


Figure 11.6. Horizontal engine lathe (Courtesy Danville Metal Stamping)

three thousand years, they were still using sticks and stones and copper saws and drills. It seems that the evidence, not to mention human nature, proves otherwise.

Considering that the pyramids were crafted with such precision, is it surprising to find circumstantial evidence that proves that exact and robust machine-tools existed in prehistory? Such machines did not just saw blocks for the pyramids and temples, but they also crafted delicate and precise stonework, such as the Ramses statues and the stone bowl fragments discovered by Petrie. Could we re-create the granite and basalt boxes in the Serapeum without employing some fairly sophisticated machinery? If we did not have the materials to devise such machinery, had not developed an understanding of metrology, and were without an inventory of instruments to measure precisely, how would we achieve these miracles in stone? Is anyone today willing to take on the fabrication of an Apis Bull box?

Petrie not only provides us with a cogent description of the use of lathes in ancient Egypt, a talent that most likely made his ideas controversial, he also describes an artifact that has been the topic of much discussion over the years. I became aware of the discussion in 1995, when I

Figure 11.7. Horizontal CNC lathe (Courtesy Danville Metal Stamping)

received an e-mail from a man who had read my 1984 *Analog* magazine article and started the discussion on dejanews.com. The original article was subsequently published in other magazine articles, the editors of which were attracted to the controversial content and that perhaps it provided answers to how the ancient Egyptians performed inexplicable feats of stone cutting. The method I had postulated is that ultrasonic machining may explain the characteristics found in a very unique artifact in Petrie's collection.[8] This artifact is described by Petrie as 7 G (see figure 10.13, p. 261; more popularly known as Core 7) and is housed in the Petrie Museum (see figure 11.8). The hypothesis of ultrasonic machining stimulated both positive and negative reactions, with those who opposed the idea offering helpful suggestions on how my mind might be changed.

Figure 11.8. Petrie's Core 7 G, housed in the Petrie Museum, University College London, UC16036, granite, height 4.33 inches (11 centimeters)

Petrie's drawing of Core 7 and his thorough description formed the basis of my analysis. Petrie describes it:

> On the granite core, broken from a drill hole (No. 7), other features appear, which can only be explained by the use of fixed jewel points. Firstly, the grooves which run around it form a regular spiral, with no more interruption or waviness than is necessarily produced by the variations in the component crystals; this spiral is truly symmetrical with the axis of the core. In one part a groove can be traced, with scarcely an interruption, for a length of four turns. Secondly, the grooves are as deep in the quartz as in the adjacent feldspar, and even rather deeper. If these were in any way produced by loose powder, they would be shallower in the harder substance—quartz; whereas a fixed jewel point would be compelled to plough to the same depth in all the components; and further, inasmuch as the quartz stands out slightly beyond the feldspar (owing to the latter being worn by general rubbing), the groove was left even less in depth on the feldspar than on the quartz. Thus, even if specimens with similarly deep grooves would be produced by a loose powder, the special features of this core would still show that fixed cutting points were the means here employed.
>
> Next the Egyptians adapted their sawing principle into a circular, instead of a rectilinear form, curving the blade round into a tube, which drilled out a circular groove by its rotation; thus, by breaking away the cores left in the middle of such grooves, they were able to hollow out large holes with minimum of labour. These tubular drills vary from ¼ inch to 5 inches in diameter, and from 1/30 to 1/5 thick. The smallest hole yet found in granite is 2 inches diameter, all the lesser holes being in limestone or alabaster, which was probably worked merely with tube and sand. A peculiar feature of these cores is that they are always tapered, and the holes are always enlarged towards the top. In the soft stones cut merely with loose powder, such a result would naturally be produced simply by the dead weight on the drill head, which forced it into the stone, not being truly balanced, and

so always pulling the drill over to one side; as it rotates, this would grind off material from the core and the hole. But in the granite core, No. 7, such an explanation is insufficient, since the deep cutting grooves are scored out quite as strongly in the tapered end as elsewhere; and if the taper was merely produced by rubbing of powder, they would have been polished away, and certainly could not be equally deep in quartz as in feldspar. Hence we are driven to the conclusion that auxiliary cutting points were inserted along the side, as well as around the edges of the tube drill; as no granite or diorite cores are known under two inches diameter, there would be no impossibility in setting such stones, working either through a hole in the opposite side of the drill, or by setting a stone in a hole cut through the drill, and leaving it to project both inside and outside the tube. Then a preponderance of the top weight to any side would tilt the drill so as to wear down the groove wider and wider, and thus enable the drill and the dust to be the more easily withdrawn from the groove. The examples of tube drilling on Pl, viii. are as follow:—No. 7, core in granite, found at Gizeh. No. 8, section of cast of a pivot hole in a lintel of the granite temple at Gizeh; here the core being of tough hornblende, could not be entirely broken out, and remains to a length of .8 inch. No. 9, alabaster mortar, broken in course of manufacture, showing the core in place; found at Kom Ahmar (lat. 28° 5′), by Prof. Sayce, who kindly gave it to me to illustrate this subject. No. 10, the smallest core yet known, in alabaster; this I owe to Dr. Grant Bey, who found it with others at Memphis. No. 11, marble eye for inlaying, with two tube-drill holes, one within the other; showing the thickness of the small drills. No. 12, part of the side of a drill-hole in diorite, from Gizeh, remarkable for the depth and regularity of the grooves in it. No. 13, piece of limestone from Gizeh, showing how closely the holes were placed together in removing material by drilling; the angle of junction shows that the groove of one hole just overlapped the groove of another, probably without touching the core of the adjacent hole; thus the minimum of labour was required. The examples of tube drilling on a large

> scale are the great granite coffers, which were hollowed out by cutting rows of tube drill-holes just meeting, and then breaking out the cores and intermediate pieces; the traces of this work may be seen in the inside of the Great Pyramid coffer, where two drill-holes have been run too deeply into the sides; and on a fragment of a granite coffer with a similar error of work on it, which I picked up at Gizeh. At El Bersheh (lat. 27° 42′) there is still a larger example, where a platform of limestone rock has been dressed down, by cutting it away with tube drills about 18 inches diameter; the circular grooves occasionally intersecting, prove that it was done merely to remove the rock.[9]

The most startling feature of the granite core Petrie describes is the spiral groove around the core indicating a feed rate of 0.100 inch per revolution of the drill. In my article, I stated that this feed rate was five hundred times *faster* than modern diamond drills, which penetrate at only 0.0002 inch per revolution. This has been incorrectly interpreted by some, who have concluded that a hole of the same dimension could be drilled five hundred times faster by the ancient Egyptians than by modern drills. The correct way to describe the feed rate would be to say it was five hundred times *greater* than modern diamond drills, but the rotation of the drill would not have been as *fast* as the modern drill's nine hundred revolutions per minute.

When I read Petrie's description of this drill core, I tried to imagine what kind of process could replicate it. It seemed very clear that the spiral groove that wound down the core like a drunken screw (Petrie's description) could not have been made by any loose grains rubbing on the granite. Petrie notes that the groove cut deeper through the quartz than the feldspar, which in conventional drilling would actually be the reverse, because quartz is the harder material. The taper on the core and the hole were also quite puzzling, because they did not lend to the idea that the groove was cut while a rotating tool was withdrawn from the hole. Yet the action of a tool that reflected a feed rate of 0.100 inch per revolution of the drill was not the work of conventional drilling as

we know it and demanded consideration of other processes in its creation. All of these features were considered without the physical examination of the artifact in question and were considered phenomenal not just by me alone, but also by colleagues with whom I discussed their relevance.

It seemed from the evidence described by Petrie that a sure way to create the spiral groove was to use a process whereby the tool oscillated, like a jack hammer or hammer drill, while it turned. I selected the method to be ultrasonic (see figure 11.10), because with quartz having

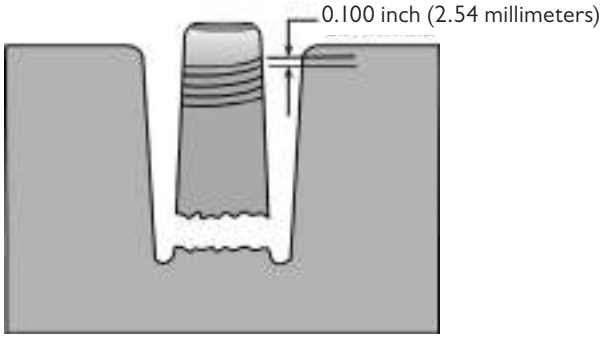


Figure 11.9. Egyptian core drilling hole and Core 7

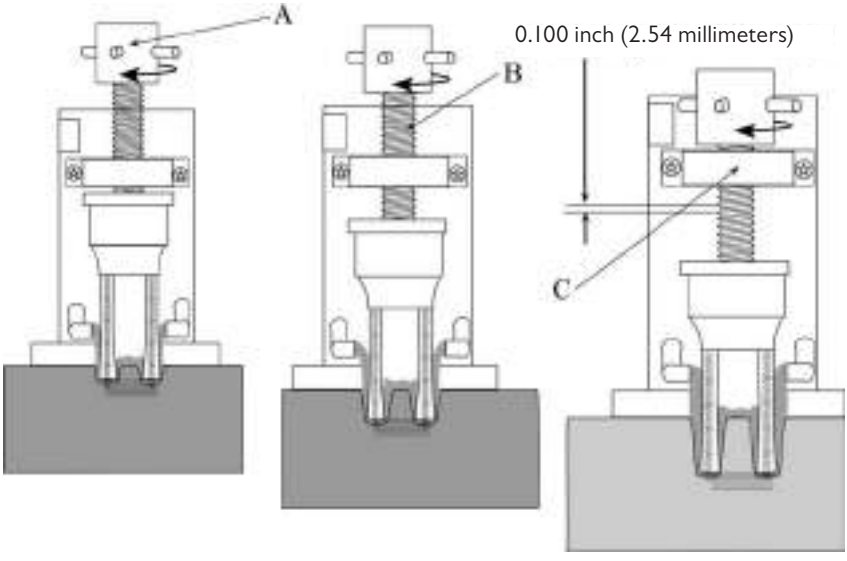


Figure 11.10. Ultrasonic machining of granite

resonant properties, it would respond to the vibration and this might explain the deeper cut through the quartz than the feldspar.

Figure 11.10 shows a basic concept of how the drill worked. The core drill was attached to an assembly that included a horn assembly and transducer and a threaded shaft (figure 11.10 B). While axially oscillating, the assembly was turned by way of a turn knob (figure 11.10 A) through a nut assembly (figure 11.10 C).

This idea, of course, while popular in some circles, was certainly not popular among Egyptologists, one of whom is Denys Stocks, who writes, "Despite this apparent abundance of evidence, many people still argue that these simple tools were not capable of producing the artifacts that survive and, therefore, that there had to be some as yet undiscovered technology that the Egyptians possessed. These supposed technologies include diamond-tipped saws and drills and even the use of sonic waves to cut stone."[10]

Stocks goes on to claim in his article that he had been able to replicate and demonstrate the efficiencies of the tools we "know" were in the ancient Egyptians' toolbox. His work is exhaustive and goes to great length in describing every step of his methods, and it includes photographs of bow drills, copper chisels, stone axes, and copper tubes for grinding into diorite using sand as well as an example of a small urn being drilled.

With such a comprehensive and complete study of how simple, primitive tools were applied in prehistory, and with the support of academia behind him, it would seem that the subject of ancient technology was an open-and-shut case. Yet because we have already examined two theories on ancient saws and found them lacking, Stocks's efforts to prove how the ancient Egyptians drilled granite using core drills must be examined more closely.

Mike Brass, a South African Egyptology student, first advised me of Stocks's effort to drill granite using a copper tube and sand. I must admit I did not take it seriously, as it conflicted with Petrie's assertions based on his observations of the core in his possession, and the idea was counter to my own personal experience and knowledge of the capabilities

of drills. Therefore, I did not refer to it when my article was reprinted. I probably should have given it more attention, for it is the simplest method devised because it demands the introduction of the least number of unproven assertions. The materials are already in the archaeological record, and pictorial images can be interpreted as ancient Egyptians using those materials in their working of stone. The experiments by Stocks are lodged firmly in the academic record and are referenced by Deiter Arnold in *Building in Egypt*.[11] This should be enough, we might think, to accept those findings and look no further for answers.

Yet there is that nagging question spiraling around Core 7 in the Petrie Museum. Stocks described the results of a drilling experiment that was conducted in 1999 as part of his involvement with the Lehner/Hopkins *Nova* obelisk experiment. Regarding a core that he ground out of granite using quartz sand and a copper tube attached to a shaft and manually driven by a bow and sand, he writes, "Horizontal striations similar to the ancient ones on rose granite were visible both in the wall of the hole . . . and upon the core."[12, 13]

Stocks's seemingly innocuous statement actually speaks to the heart of the debate regarding the technology used by the ancient Egyptians to drill granite. Horizontal striations, as opposed to helical grooves, would sink the sonic machining theory in a sea of vibrating quartz quicksand, where it will forever rest and, perhaps, be remembered by some as an interesting yet troublesome theory and by others as the product of an overactive imagination. When we look at Core 7 and the drunken crawl of the groove around its circumference, there seems to be a lack of order and certainty to them. Is it possible that Petrie was mistaken or confused when he described this core? Lucas and Harris were not convinced that his evidence supports his conclusion that jewel teeth were set in bronze saws and tubes to create these grooves, but they did not question his observations that the groove was spiral and not horizontal. In *Ancient Egyptian Materials and Industries,* they write:

> In my opinion, to suppose the knowledge of cutting these gem stones to form teeth and of setting them in the metal in such a man-

ner that they would bear the strain of hard use, and to do this at the early period assigned to them, would present greater difficulties than those explained by the assumption of their employment. But were there indeed teeth such as postulated by Petrie? The evidence advanced to prove their presence is as follows:*

(a) A cylindrical core of granite grooved round and round by a graving point, the grooves being continuous and forming a spiral, within one part a single groove that may be traced five rotations round the core.
(b) Part of a drill hole in diorite with seventeen equidistant grooves due to the successive rotation of the same cutting point.
(c) Another piece of diorite with a series of grooves ploughed out to a depth of over one-hundredth of an inch at a single cut.
(d) Other pieces of diorite showing the regular equidistant grooves of a saw.
(e) Two pieces of diorite bowls with hieroglyphs incised with a very free-cutting point and neither scraped nor ground out.[14]

Petrie's observations of a helical groove were explained by Stocks to be the result of the random action of quartz sand in the drilling process. This process produces, for the most part, horizontal striations, which he noted in his drilling experiment.[15]

Other experiments were made by Leonard Gorelick and A. John Gwinnet of the School of Dental Medicine S.U.N.Y at Stonybrook, who show the results of drilling using a copper tube and emery grit, a component of which is magnetite and corundum. Corundum has a hardness of Mohs 9. Gorelick and Gwinnet claimed that by using emery, they were successful in grinding out concentric grooves in glass, but indicated that quartz sand would not perform as well.[16]

Seeking to resolve the question of helical versus horizontal grooves, two men set about verifying them by examining the central piece of

*W. M. F. Petrie, *Journ. Royal Anthrop. Inst.,* XIII (1884), pp. 90, 103–4; "Pyramids and Temples of Gizeh," pp. 173–74; "Arts and Crafts," p. 73; "Tools and Weapons," pp. 44–45.

evidence that was located in the Petrie Museum. John Reid, an acoustics engineer who is noted for his work on pyramid acoustics, and Harry Brownlee, an expert stonemason and sculptor, concluded after their inspection of Petrie's Core 7 that the grooves were horizontal, not helical, as described by Petrie.

In their book *Giza the Truth,* Ian Lawton and Chris Ogilvie-Herald write:

> They [Reid and Brownlee] make the critical distinction, not effectively made by Dunn, between the *horizontal* striations that are found on all cores—these being separate grooves, which are on close inspection randomly spaced—and *spiral* striations, which are genuinely connected spiral grooves. Petrie reports that he found these latter on only *one* piece, which he examined—our old friend drill core 'No. 7', whereon he described four connected spiral turns. Reid and Brownlee have examined and photographed this core in minute detail, and report that even on this they can detect only *horizontal* striations [see plate 26]; they can only conclude that there may be some confusion in the labeling of the artifact at the musem.[17]

While Lawton and Ogilvie-Herald stress that Petrie found the spiral striations on only one piece, this is not true. As Lucas and Harris state, other examples were found and noted by Petrie: "Another piece is part of a drill hole in diorite. This has been part of a hole 4½" in diameter, or 14" circumference as the seventeen equidistant grooves appear to be due to successive rotations of the same cutting point, we have here a single cut 20 feet in length."[18]

Thanks to the publication of Lawton's and Ogilvie-Herald's book, I now had knowledge of where Core 7 was housed and went to London to examine it myself. I had taken Petrie's word on his observations of a spiral groove and had made assertions based on his observations. Because of the controversial nature of my theory, and the questions raised by Lawton and Ogilvie-Herald, I suspended those assertions subject to my own observations. It should not have been a surprise to me that not

only would I be criticized heavily for my theory of ultrasonic drilling, but also that Petrie's critical observations, which I used to support my conclusions, would also be questioned and ultimately rejected, for if they were to stand as observed by Petrie, then the theory that ancient drill holes were cut using copper and sand would be difficult, if not impossible, to substantiate.

It is noteworthy that Reid and Brownlee are confident in describing horizontal striations. On a truncated cone such as Core 7, it requires more than visual inspection to determine if a groove with a slight pitch, or distance between the start and end point in a 360° turn, is helical or horizontal. Petrie provided dimensions in his analysis, while neither Stocks nor Reid nor Brownlee nor Lawton nor Ogilvie-Herald have produced any measurements to support their assertion that Petrie's observations were incorrect—only that they "had examined the core in minute detail."[19] Petrie, on the other hand, following his lecture to the Royal Anthropological Institute on April 24, 1883, in which he received comments from several attendees who proposed that his findings were more likely to have been produced using abrasives such as emery powder or corundum, provided a footnote for his article that appeared in the RAI's Journal the following year. The footnote provided a further analysis he had made of the core in which he took specific measurements of the groove at 90° angles around its 360° circumference four times.

> In consequence of remarks on the granite core I have examined it more carefully. It offers apparently a complete proof that the lines were cut by fixed points, and not by rubbing of a loose powder; for the grooves are cut as deeply in the quartz as in the feldspar. And the feldspar being somewhat rubbed down, by general friction, the lines are actually cut through a greater thickness in the harder quartz which stand above the feldspar. Now no loose power could cut down to exactly the same depth in material of different hardness like quartz and feldspar; still less would it cut more out of the prominent quartz; but a fixed point must cut to the same depth in each material.

PETRIE'S CORE MEASUREMENTS.[21]

Rotation	0°		90°		180°		270°		360°		Pitch	
	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
Turn 1	3.14	7.98	3.11	7.90	3.07	7.80	3.08	7.82	3.06	7.77	0.08	0.20
Turn 2	3.06	7.77	3.03	7.70	2.99	7.59	2.97	7.54	2.95	7.49	0.11	0.28
Turn 3	2.95	7.49	2.94	7.47	2.91	7.39	2.87	7.29	2.83	7.19	0.12	0.30
Turn 4	2.83	7.19	2.82	7.16	2.80	7.11	2.77	7.04	2.76	7.01	0.07	0.18
Average	2.995	7.607	2.975	7.557	2.942	7.473	2.922	7.422	2.99	7.59	0.095	0.241

The spiral was described as a "drunk screw"; I therefore traced very carefully a normal plane at right angles to its axis and measured off the distances to the spiral: they are thus, at successive quarter turns in inches.*[20]

Here if there were any "drink" in the screw it would appear as an irregularity in the order of the means of each quarter; whereas they proceed as regularly as the small variations due to the texture will permit. There is not $^{1}/_{100}$" irregularity in the mean spiral, though the pitch is $^{1}/_{10}$".

The spiral could not be produced by the mere withdrawal of the tool as it is too deeply cut to have been made without great force and it is wholly unlikely that a tool should be withdrawn with such regularity. Again as there would be from $^{1}/_{10}$" to $^{2}/_{10}$" of loose dust between the tool and the tapered end of the core, the cutting points of the crown would not reach it on withdrawal, and if they did so accidentally they would not touch the core in a continuous line all round, but only on one side.

That there are lines on modern drill cores is not the point. These cores are not tapered and hence the lines there can be produced by the crown.

*Added to Petrie's table are metric measurements and distance (pitch) between the start point and end point of each turn, which have also been changed from quarter turns to degrees.

> On examination, it seems most probably to me that the coning was not due to stones set in different projections, but rather by a row of stones up the side projecting uniformly. Then when the top weight was tilted over to one side, or did not balance truly on the drill head, it would drag the drill over and thus make it enlarge the hole and taper the core as it cut downwards.
>
> An engineer present has remarked to me that the manufacture of hammers good enough to dress down granite on such a very large scale, as in the Great and Third Pyramids, implies almost as much skill as any other method of dressing the stones.[22]

It is easy to be mistaken when we examine Petrie's Core 7 to try to determine if the grooves are spiral or horizontal. It is especially easy to make a mistake if we examine a photograph in which the core is tilted to one side—such as in the photograph pictured in *Giza the Truth*. Before traveling to England to examine the core firsthand, I suspected that their conclusions were in error after I examined their photograph in my graphics program. Plate 25 A shows Core 7 as seen in *Giza the Truth*. Plate 25 B shows Core 7 in a corrected orientation with a vertical central axis. A construction reference frame is provided so that the tilt can be seen, and a horizontal dashed line was added to compare it with the grooves on the granite core. The horizontal dashed line indicates that the grooves appear to be horizontal in plate 25 A and tilted in plate 25 B.

Jon Bodsworth of the UK has also taken a photograph of the granite Core 7, and it is frequently displayed on the internet tilted on a similar angle as the photograph in *Giza the Truth* angle and used to deny Petrie's spiral thread observations. To further explain the problem with analyzing a tapered thread when it is tilted on an angle, see figure 11.11, which is a common ¾-inch pipe thread with 14 TPI (threads per inch). As you can see on the left, the pipe is tilted on an angle similar to the angle of Core 7 in plate 26 A. The horizontal reference line indicates that the thread is horizontal. The pipe on the right is in the correct orientation, and the reference line shows the thread as it should be—

around 180 degrees of the diameter in view, the line travels from the crown of the thread to the root.

The problem with analyzing a photograph of Core 7 is that, as Petrie pointed out, the groove wanders from side to side from a theoretical perfect helix. He noted that the groove doesn't vary more than $^{1}/_{100}$ inch (0.010 inch; 0.254 millimeter). Yet with one thread wandering either toward or away from an adjacent thread, the published photographs by Lawton, Ogilvie-Herald, and Bodsworth have served to weaken Petrie's argument.

Notwithstanding my suspicions, I had to travel to London to have a firsthand look at the evidence. I contacted a colleague, Nick Annies, who lives near Cambridge, and he kindly arranged for us to visit the Petrie Museum and assisted me in the examination of the core. I am greatly indebted to him for his generous hospitality and support while I was in England during this period. As I pondered how to measure the groove on the core, I considered a fixture that would rotate it while a stylus traced the groove. This seemed too elaborate, even though it would have provided quantitative measurements. I didn't intend to measure every departure from a true helix that the groove may follow, but instead, I wanted to determine whether, as Petrie measured, it was actually a helix at all. I had only to confirm Petrie's observations that this was not a horizontal groove that began and ended at the same point—regardless of where that point was on the circumference.

The simple and most visual test to demonstrate this would be to wrap a common white cotton thread around the core, making sure it followed

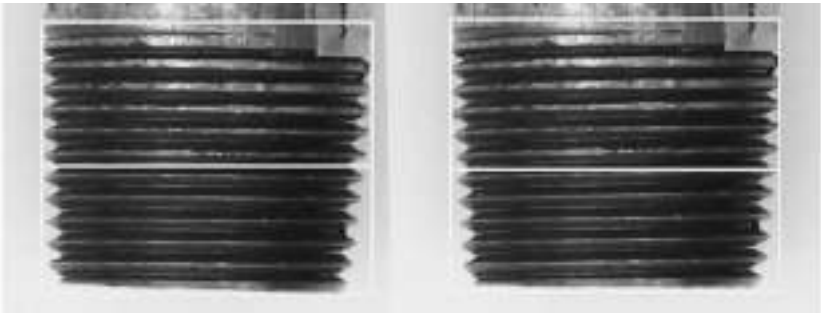


Figure 11.11. Threaded pipe tilted at the orientation of Core 7

the same groove. This test was performed on November 15, 1999, and results were posted at www.gizapower.com/petrie/petrie1.htm. Some readers objected to my observations and continued to accept Reid and Brownlee's observations as factual, even though, unlike Petrie and me, they had not produced anything other than a photograph of a tilted core and an opinion based only on that photograph. After examining the core myself, I was convinced of the correctness of Petrie's observations, but I realized that I had to gather even better evidence to support them.

Gas turbine engine–manufacturing engineers are very familiar with large and small cones that have varying ratios of height to top and bottom diameters. Sheet metal cones start out as a flat blank. They can be rolled either with or without any geometric features machined around the body of the cone. Today, this work is performed with computer software by which an engineer can create a cone, apply geometric features to its surface, and then unwrap it into a flat blank. The special software algorithms provide the geometry as it needs to be machined in the flat blank. With this in mind, and with my own testimony as well as Petrie's dismissed, it became imperative that I obtain a latex impression of the core so that I could present the grooves on a flat blank. This would make the entire surface of the cone visible, dismissing any doubt about the correctness of Petrie's observations and measurements.

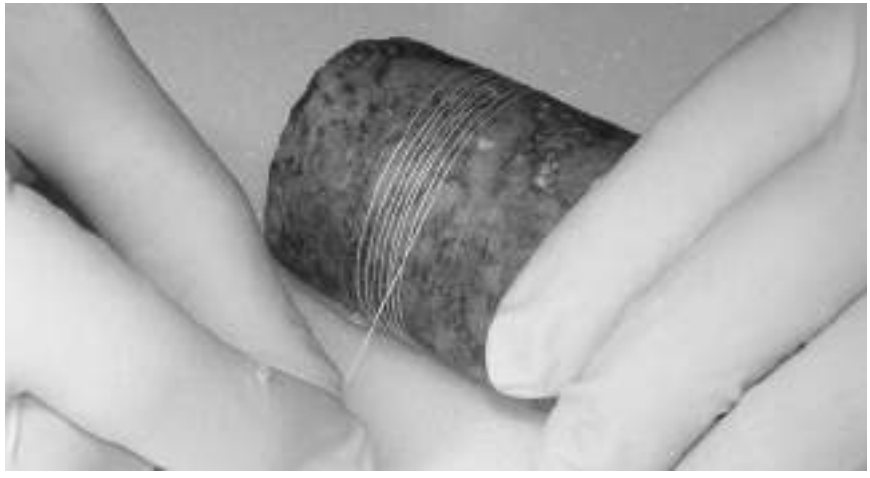


Figure 11.12. Core 7 with white cotton thread wrapped along a spiral groove

Following my first visit to the Petrie Museum, a geologist in England who was also interested in Petrie's Core 7 and had read both Petrie's work and mine contacted me via e-mail. Malcolm McClure had retired from British Petroleum and had a passion for investigating anomalous events from history and the present. McClure had found solutions to most mysteries, he told me, but was still not satisfied with what has been written regarding the grooves on Petrie's Core 7. He was not convinced they were horizontal, but he was also not quite convinced by Petrie or me that they were spiral either. I explained my dilemma to Mr. McClure and explained that I needed to examine the core again and also have a latex impression made of the core so that the grooves could be examined in two dimensions laid out flat. He contacted Dr. Stephen Quirke, the curator of the museum, and I gained permission to perform another analysis.

I arrived in England on March 30, 2003, and enjoyed the generous hospitality of Graham Hancock and his wife Santha Faiia, who provided me with accommodation in their London home. The following day I met Mr. McClure and Nick Annies, who would assist by taking photographs with his digital camera, and after breakfast at the University College London student hall, we headed over to the Petrie Museum.

I performed the same thread wrap around the core with Mr. McClure and Mr. Annies observing closely. After achieving sixteen wraps around the core, I could sense that Mr. McClure was anxious to try it himself, and he eagerly took the core and thread from me and set to work wrapping the thread around the core, being careful to fit it into the groove as he went. After performing several wraps himself, he declared that he was speechless, and pondered whether he, being the observer and knowing of the spiral claim for the core, had affected the outcome. This is because there are discontinuities in the groove, which is why Petrie noted only four continuous turns. Using the thread, and reaching a point in the turn where a discontinuity exists, uncertainty exists as to where the groove picks up again.

After our work was finished, we met with Dr. Stephen Quirke and discussed the possibility of having a latex mold made of the core. Dr. Quirke said he would forward the request to the conservationist, James

Hale. He also indicated that he looked forward to seeing the controversy surrounding this artifact eventually settled. Evidently, he fielded another request from a person who wished to perform an analysis on the core to see if, by rotating it and putting a phonograph needle in the groove it might reveal untold secrets from the past.

The latex peel provides another view of Core 7 and valuable information regarding the spiral groove's regularity and frequency along the length of the core. I received the latex impression in the mail in 2003, but my time and attention shortly thereafter became consumed with personal and family matters, and it sat for several years before I examined it. When I finally began to work with it, the edges had begun to split, so I knew that my intention of mounting it on a tapered mandrel would not work. Instead, I inserted a plastic tube on its interior and cut two square holes along its length near the splits. Then I cut a line between the square holes and continued with the cut to join with the splits at the ends (see figure 11.13).

It was my intention to unfold the latex into a flat blank and examine the grooves with the blank oriented to the notches. If the grooves were horizontal, they would appear as an arc that started and ended at the same point. Orienting the blank by using the notches that were once joined, I could analyze the entire surface. As seen in figure 11.14, points A and B identify the start and end point of an arc that would be horizontal or would have the same start and end point. Points C and

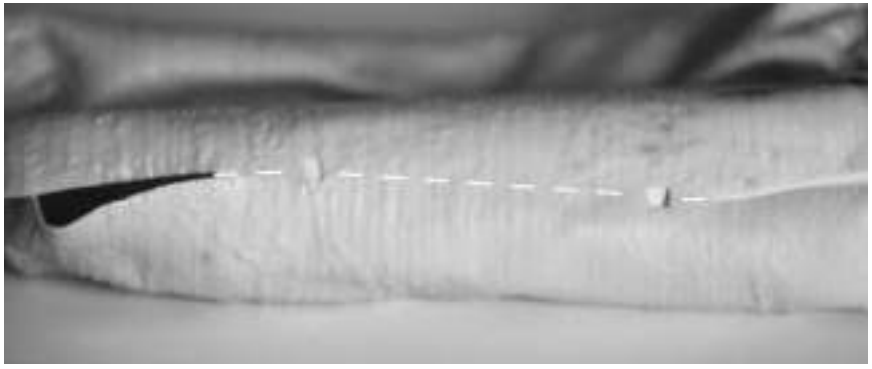


Figure 11.13. A latex impression of Core 7 showing notches and cut lines

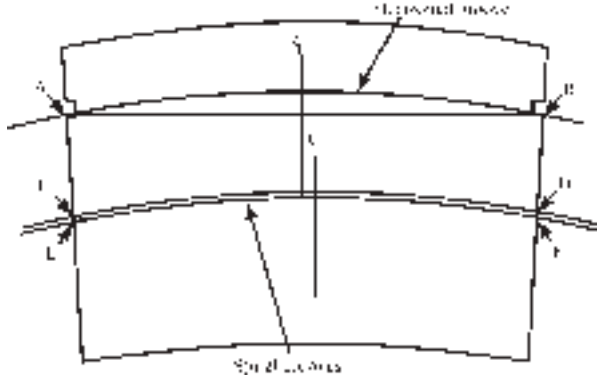


Figure 11.14. Geometry of a spiral groove on the unfolded latex impression of Core 7

D do not have the same start and end point and, therefore, represent a spiral groove. Point C joins with point F, completing one turn of the spiral and starting another.

I then flattened the latex on a piece of white construction board and photographed it using an 8-megapixel camera. Plate 26 has been color enhanced in order to highlight the grooves, and I have applied construction lines and arcs. Readers are welcome to perform their own analysis of these photographs, but my final conclusion based on Malcolm McClure's and my on-site inspection as well as the flat layout of the surface with arcs applied is that the groove around the Petrie Core 7 is a spiral rather than individual horizontal striations as claimed by Reid and Brownlee and others. Moreover, this spiral groove travels the full length of the core, and any discontinuities are due to the ripping out of the mica—a constituent of the granite—with some discontinuities seen as faint lines on the latex peel, but on the granite core they cannot be seen with the naked eye. On the whole, the quartz seemed to be fairly intact, but the extent of the ripping in the mica was extensive.

Taking into consideration Petrie's own account, my inspection in 1999, and Malcolm McClure's and my inspection in 2003, along with analysis of the latex impression of the core, the question as to whether the groove is horizontal or spiral appears to be answered. The groove follows a continuous helical path around the circumference of the core

down its full length, with periodic discontinuities along the way.

As seen in the close-up photographs of the latex impression, the irregularities in the groove cannot be overlooked and seem to argue against the theory that a tool with a precise mechanism for advancement was used. These inaccuracies, along with random movement of material removed from the hole during the process, though, support a strong argument that either a manual or an inaccurate, mechanically controlled tool played some part in performing the work. Upon closer inspection, I find no evidence to support the theory that ultrasonic drilling was employed. In fact, there is an abundance of evidence, when we look closely at the surface of the latex, to argue against this theory.

Petrie's measurement of 0.100 inch (2.54 millimeters) distance between the grooves is not supported by the evidence seen in figure 15. The grooves seen here range from 0.050–0.080 inch (1.27–2.03 millimeters), though they depart at places and are closer to what Petrie measured. Also, the depth of the groove, as seen in figure 11.16 varies

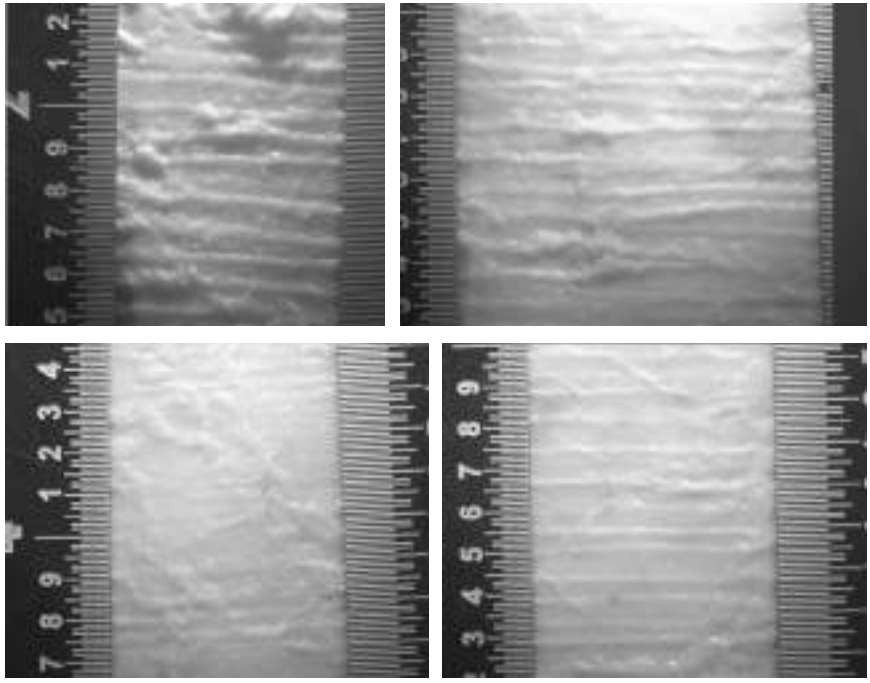


Figure 11.15. Close-up photographs of the latex impression of Core 7 showing random bubbles and diverting runs on the surface

to a maximum depth of 0.0075 inch (0.190 millimeter). Inexplicable features that become more prominent when seen on the magnified surface are the raised areas where, presumably, material was by some means gouged out in the drilling process. They appear like bubbles on the surface. The latex impression also clearly reveals an addition to the grooves, with short grooves (or runs) connecting one groove to the next in a relatively short distance. In some areas, the additional run is almost vertical to the axis of the core. This feature is not clearly evident on the core itself and is not mentioned by Petrie or any other observer that I am aware of.

After failing to obtain a good photograph of Denys Stocks's drilling experiments, other than what was in his published articles and book, I was left wondering whether there can be any reasonable link between the methods he used and those the ancient Egyptians used and impressed upon their granite. Though Mr. Stocks indicated that final twisting of the drill at the conclusion of the drilling created the spiral grooves, it is hard to believe that random scratches from a reciprocating bow drill would organize themselves into a continuous spiral down the

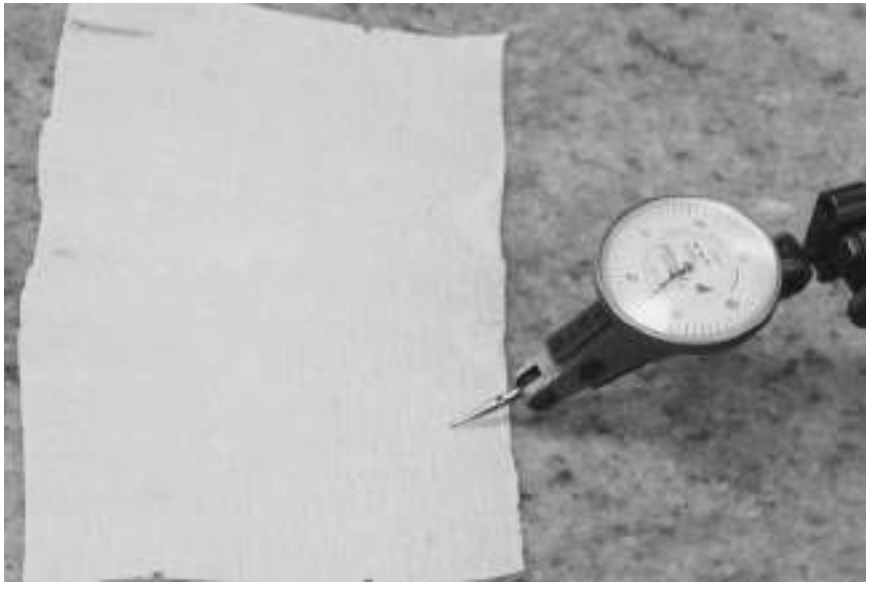


Figure 11.16. Inspecting depth of groove on latex impression

length of the core with a few twists of the drill. Nonetheless, Stocks is the man with the evidence that allowed him to form this opinion, so without access to his evidence, I was left with no option but to drill a piece of granite myself.

I obtained a piece of red granite from a local monument dealer and defined the outside diameter of a 2.125-inch (5.4-centimeter) copper tube on the top of a flat surface of the granite. After chiseling a shallow groove around the marked circle using a carbide-tipped drill point, I then poured silicon carbide 80-mesh grit into the groove. (Silicon carbide has a Mohs hardness of 9.5, whereas quartz sand has a hardness of Mohs 7, the same hardness as the quartz in the granite.) I then began to rotate the drill assembly, which was weighted with 60-pound (27.215-kilogram) lifting weights, clockwise and counterclockwise. At first I tried using a bow strung with leather cord but found it inefficient and awkward, so I equipped the assembly with a common machine handle and rotated it without the bow. I doubt that the granite knew the difference.

After reaching about a 0.25-inch depth, I switched to a diamond hole saw and took the hole to its maximum depth of 1.64 inches (4.165 centimeters). Then I inserted the copper tube again and worked the hole down further. Having my hands in contact with the drill assembly was beneficial, as I was able to feel when fresh grit was needed to be introduced into the slot—it didn't take long for the grit to wear down to nothing but dust, and the difference in the vibration through the drill assembly between fresh grit and dust was substantial.

As I worked the tube deeper into the granite, I consciously wobbled it more than I needed to so that the surfaces of the core and the hole were ground away. After reaching a depth of 2.265 inches (6.73 centimeters), I used a copper wedge-shaped mandrel and attempted to knock the core out of the hole. Stocks does not say what material his chisels were made from, but I assume they were copper as the ancient Egyptians allegedly didn't have steel. If so, he was more successful than I, because my copper wedge wouldn't budge the core and became deformed as the granite resisted the copper's inherently soft characteristics. Ultimately, I resorted to a steel chisel and with one blow the core gave way.

The statistics of the hole, core, and drills are as follows:

Hole	
Diameter at the top	2.18 inches (5.54 centimeters)
Depth	2.265 inches (6.73 centimeters)
Core	
Diameter at the top	1.935 inches (4.914 centimeters)
Diameter at the bottom	2.005 inches (5.09 centimeters)
Copper tube	
Outside diameter	2.125 inches (5.397 centimeters)
Inside Diameter	2.00 inches (5.08 centimeters)

Although I tilted the tube intentionally to the side after using the diamond hole saw, striations made by the diamond were not all ground away. The areas where they exist on the core are evident in figure 11.18. The larger percentage of their marks, however, were removed as the tube ground the hole to depth. The diamond hole saw striations reveal that another method, suggested by Petrie, does not produce the kind of spiral groove evident on Core 7. Similarly, the area worked with abrasive and copper do not produce the striations revealed in ancient Egyptian holes, i.e., figure 11.18 top left and top right, which are reflected on Core 7.

Another feature that was evident as a result of my drilling experiment, and which also serves to dispel both the copper and abrasive *and* the theory of ultrasonic drilling, is the finish on the surface of the hole and core. When using sand, or any other abrasive to remove material, what other finish would we expect other than a sanded finish? Even if I was able to dig deeper grooves into the granite, as I am sure Stocks was able to, the surface finish on the granite using an abrasive method is unlike the surface finish on Core 7 or on the holes that the ancient cores came out of. As we can see in plate 25, Core 7 is not sanded, but appears to have a polish to it.

Figure 11.17. Top: Drilling rig. Bottom: Hole and core with chisel wedge and hammer.

With respect to what methods the ancient Egyptians used to create Core 7, I have no real answers. However, to replicate the core and holes, an experimentalist might consider softening the granite using heat. Does the burnished finish on the surface of Core 7, as well as the random runs between the grooves and the proliferation of depressions where mica is removed, along with the spiral groove itself, indicate that these characteristics might be replicated if the granite was brought close to its melting point?

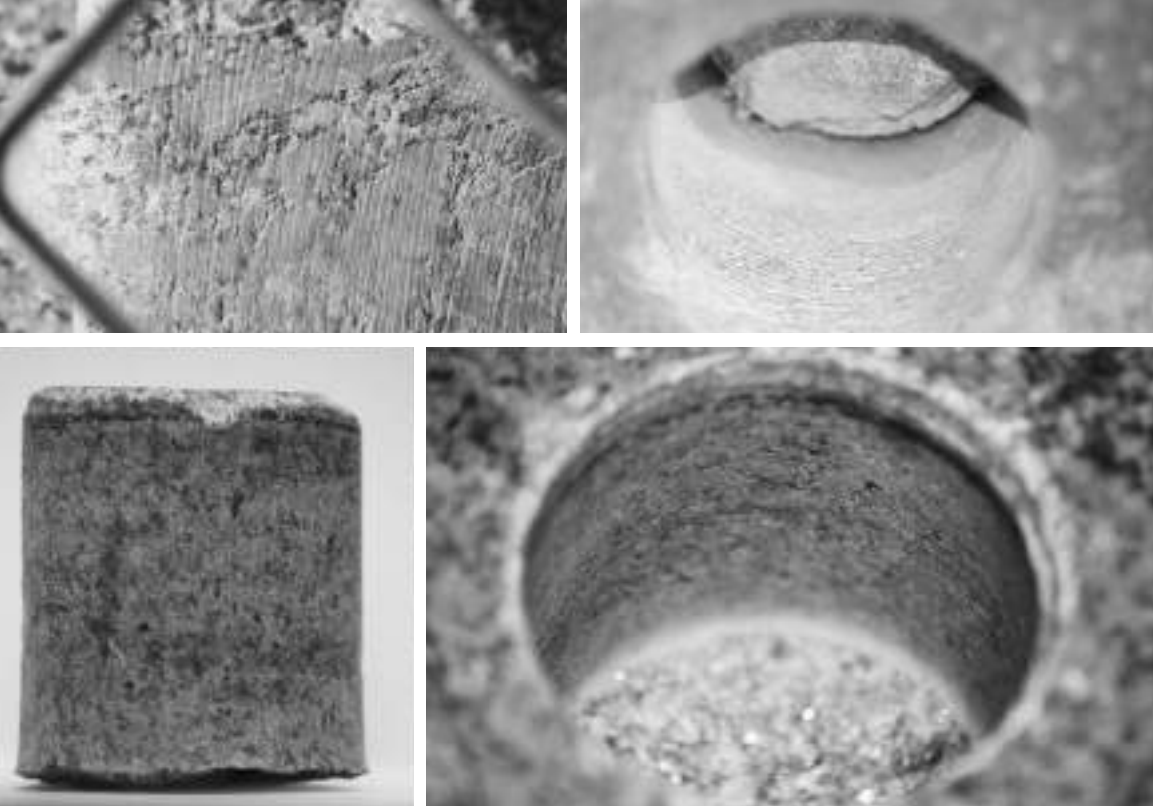


Figure 11.18. Top left: Drilled hole at Abu Ghorab (courtesy Patrice Pooyard). Top right: Close-up of drilled hole in the Valley Temple lintel block. Bottom left and right: Drilled hole and core using a copper tube and silicon carbide 80-mesh abrasive.

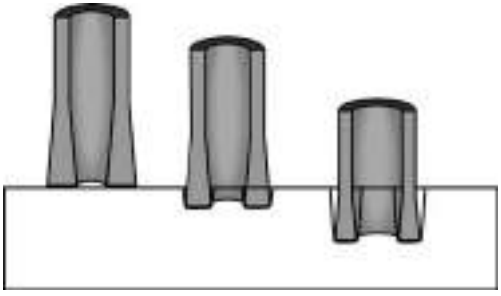


Figure 11.19. Example of wear on the cutting edge of a tubular drill

Such a method may involve using a tool—similar to a thermal lance—that sacrifices its material in the process, as depicted in figure 11.19. Until an answer is found, Petrie's Core 7 will remain in its case at the Petrie Museum as evidence of one of Egypt's mysterious lost technologies.

12
Suspending Disbelief

Have the wisdom to abandon the values of a time that has passed and pick out the constituents of the future. An environment must be suited to the age and men to their environment.

Proverb from the Egyptian Inner Temple,
in Isha Schwaller de Lubicz,
Her-Bak: Egyptian Initiate

Here, I have attempted to provide a more complete description of artifacts that Egyptologists seek to explain in their books on ancient Egyptian craftsmanship and engineering. My analysis of the various attributes of the artifacts presented is by no means exhaustive, but it provides us with a better idea of what steps researchers must take in order to say with conviction that they have discovered the means by which the ancient Egyptians built their civilization in stone.

As we come to grips with what has been discussed here, it would help if I arranged—in order of significance, from a manufacturing perspective—the artifacts that I have discussed in this text. I'll assign 1 to the highest level of sophistication and work down to 6, then I'll explain why I have ranked them in this order. Of course, this ordering reflects my own opinions, which are biased toward manufacturing technology. Construction engineers or architects may order them

differently, but this ordering is meant purely to provide a means to understand what could be considered the development of knowledge and the exercise of technological sophistication. My list is ordered by site and the principle artifact at the site that stands out as the most sophisticated expression of industrial art.

1. The Temple at Luxor: the Ramses statues and obelisks
2. The Temple of Denderah: the Great Hypostyle Hall columns
3. The Giza Plateau: the contoured granite blocks and the pyramids
4. The boxes in the Serapeum
5. Abu Roash: the sawed granite block
6. The Petrie Museum and the Unfinished Obelisk

Surprising to many may be my selection of Luxor over the pyramids at Giza—which have been the only surviving members of the Seven

Figure 12.1. When we wish to see, we open our eyes. When we wish to see more clearly, we open our minds.

Wonders of the Ancient World. I believe strongly that Luxor should be included on this list or should grace the top position on the newly drafted Wonders of the World (as recently voted on by people around the world). The finalists of this Internet popularity contest are, without ranking: Chichén Itzá, Mexico; Christ the Redeemer, Brazil; the Colosseum, Italy; the Taj Mahal, India; the Great Wall of China; Petra, Jordan; and Machu Pichu, Peru.

The reordering of the Wonders of the World by popular vote on the Internet was not taken kindly by Egyptian officials. Zahi Hawass would not dignify the populist poll by having the pyramids included in a contest in which the results were based on an emotional connection with a site, rather than on scholarship. In fact, he demanded that the pyramids be excluded from the voting. "Just think about it, could you have put the statue of Christ the Redeemer against the Abu Simbel?" Hawass asked, and argued further that those who have voted may not have even set foot in Luxor, Karnak, or the Valley of the Kings. "Just how could they let people rewrite history? History has been written by scholars who do important works for people to understand and respect, but this new voting is not correct. . . . We only deal with UNESCO, with official bodies and institutions, or respected individuals, but not a small tour company that does not have credibility," [1] he said.

Hawass's concerns were heeded by the organizers, and the pyramids were taken off the list for the American Idol–style voting contest. Regarding the pyramids, the organizers of the contest made conciliatory comments on their website:

> The Pyramids of Giza, the oldest and only Ancient Wonder still standing, are testimony to perfection in art and design, never subsequently achieved. They were built by planners and engineers purely to serve their earthly rulers—who were also their gods. Philosophy did not exist at this time, and creation was not subject to any questioning. The pyramids are the purest of constructions, built for eternity. After careful consideration, the New7Wonders Foundation designated the Pyramids of Giza—the only remaining of the 7 Ancient

> Wonders of the World—as an Honorary New7Wonders Candidate. Therefore, people could not vote for the Pyramids of Giza as part of the New7Wonders campaign. This decision has also taken into account the views of the Supreme Council of Antiquities of Egypt and the Egyptian Ministry of Culture. The Pyramids are a shared world culture and heritage site and deserve their special status as the only Honorary Candidate of the New7Wonders of the World campaign. The New7Wonders of the World were chosen by the people across the globe from the remaining 20 New7Wonders candidates.[2]

The results of the poll are difficult to accept for many people because they are the result of votes cast by people who may have not visited any of the sites or may have only visited one or two. The poll also lacked specific details of each of the sites, as well as instructions on what criteria were to be used in forming an opinion. Nonetheless, it captured the imagination of one hundred million people around the world, each of whom voted for their favorite world heritage site, and I am sure if the pyramids had been included in the worldwide vote, they would surely have been voted 1 on the list.

Picking a "favorite" among the treasures left behind by generations past is a personal matter and one that speaks to the emotional attachment we form with a site. Descriptions and photographs of Machu Pichu have always captured my imagination, but when I visited the site in 2005, I was left without the sense of awe and wonder that I expected. Others who have visited the site claimed that to them it was like coming home, and that they felt a deep connection to the history and culture of the Andean people. Those who feel this way cannot be told that they are wrong and that they have selected the wrong site because an official body of scholars disagrees.

When I visited Egypt in 1986, I was interested only in the pyramids and had no desire to travel south to see the Egyptian temples. A couple I met at the Mena House Hotel near the Giza Plateau, confirmed my view when I ran into them after they had visited the temples and claimed they had seen enough of the temples and had become tired of

them. This all changed after I made my first visit. Subsequently, Luxor became my number one Wonder of the World because of the technological prowess expressed in its temples, statues, and obelisks.

LUXOR AND THE RAMSES STATUES

To me, the Ramses statues symbolize technology in motion. In his masterful work *The Temple of Man,* Schwaller de Lubicz demonstrates that the Temple of Amun Mut Khonsu was designed to symbolize man in motion. Key architectural characteristics of the temple were associated with different parts of the human body, and in the Ramses Hall, where the walking statues of Ramses are situated, the orientation of the hall allows the legs of the superimposed human to be positioned in a natural walking stance. This brilliant anthropomorphic analogue construction was created to harmonize with the stages of human development as well as its relationship to the universe.[3]

From the perspective of manufacturing evolution, the Ramses statues contain both the attributes of the boxes in the Serapeum (two-dimensional surfaces created from straight-line geometry) and the contoured blocks at Giza (three-dimensional surfaces created from straight-line and circular geometry) and go further in complexity to create surfaces that morph precisely between separate and different composite radial geometric shapes. That the ancient Egyptians accomplished this again and again, and that the information encoded in their statues is still accessible three thousand years after they were created, is a testament to ancient Egypt's engineers and artisans. The Ramses statues provide a legacy of ancient knowledge that has receded into the shadows of history, but like the Great Pyramid at Giza, they are still singing their song for those who wish to hear. When Dr. Zahi Hawass asked how we could compare the statue of Christ the Redeemer in Brazil to Abu Simbel, he posed a relevant question. Both are an expression of power and authority, but from an engineering perspective, they are quite different. Abu Simbel, which is fronted by four seated Ramses figures that are more than 60 feet high each, was carved from native sandstone bedrock while the statue of

Christ the Redeemer, reaching 120 feet (38 meters) in height with its pedestal, was made of reinforced concrete and soapstone. These materials were chosen for the statue's construction because of their ease of use and load capabilities, given the outstretched arms of Christ. Abu Simbel was crafted more than three thousand years ago, and work on Christ the Redeemer began in 1921 and was finished in 1932.

During the New7Wonders campaign, there was a separate campaign in Brazil called Vote no Cristo (vote for the Christ), with corporate sponsors donating large sums of money to have the statue voted into the top seven Wonders.

Meanwhile, the number one Wonder of the World according to my vote, given their materials, geometry, precision, mass, and endurance, received no attention at all, except for Dr. Hawass's simple plea to make a proper comparison. Unfortunately, his plea has apparently fallen on deaf ears.

THE TEMPLE OF DENDERAH

The pyramids at Giza and the Temple of Denderah are distinguished by their complexity. From the sheer amount of stone used in construction, the pyramids would most obviously take the number one spot, and readers of this text may still argue that they should be there. Yet from the perspective of manufacturing and precision assembly, the Temple of Denderah provides a more complex arrangement of geometric elements that required more in the way of three-dimensional surfacing techniques than anything found on the Giza Plateau.

Though the pyramids have rectangular and angular blocks that are cut and fitted with precision, the Temple of Denderah has rectangular blocks that are fitted with precision *and* have also been decorated with stunning three-dimensional reliefs *before* being assembled into the temple. On top of this, the Hathor capitals in the Great Hypostyle Hall have exact, three-dimensional surfaces that, whether cut before or after being assembled, are not only an amazing demonstration of artistry and skill, but also are precisely aligned with each other, from column to column.

THE GIZA PLATEAU

Depending on what discipline you consider to be Egypt's master craft, the Giza Plateau has sufficient evidence to move it to number one on any list of Wonders. If we consider the pyramids to have been built merely to be used as tombs, they would reside, in my view, at number three on the list. If the sophisticated science that is thought by some to reside within the pyramids' construction is proved to have merit, then they would resist all challenges for prominence among all artifacts anywhere in the world.

For the purposes of this book, however, we are focusing on the artisans' master craft, and on the Giza Plateau, the contoured blocks offer a transition between the simple, flat surface geometry found in the pyramids and the Serapeum and the more complex geometries that were revealed in the statues of Ramses II after ancient tools had plowed out thousands of tons of diorite and granite with apparent efficiency and ease.

THE BOXES IN THE SERAPEUM

The complexity of a box is not quite that of a statue or even the cornice block near the Valley Temple at Giza. Yet the message from the tunnels of the Serapeum is one of metrology and exactness. While precision is inferred from the geometry and symmetry of the statues, the boxes in the Serapeum let us know quite clearly that the ancient Egyptians were no strangers to such exactness. The lapidary work on the insides of these boxes should invite further studies by Egyptian engineers who can interpret the information that is crafted into the meticulousness with which these giant, enigmatic artifacts were made.

THE SAWED GRANITE BLOCK AT ABU ROASH

The stone at Abu Roash opens up an entirely different perspective on pyramid building in ancient Egypt. When we ponder how such a massive construction program could be executed with efficiency and precision, we

understand more if we consider that machines existed that were up to the task. The stone at Abu Roash provides an important piece of information for our understanding of how tens of millions of pyramid blocks were cut.

THE PETRIE MUSEUM AND THE UNFINISHED OBELISK

The Petrie Museum offers evidence to support the need for a reevaluation of the kinds of tools used by the ancient Egyptians to cut their statues and other stone artifacts. Petrie's Core 7 provides an important clue that a more efficient method of hole drilling was used by the ancient Egyptians than those proposed by Egyptologists. The examples of lathe work and the nicks and grooves on statues that were left by tools that could not have been simple chisels or stone balls all contribute to a radically different view of the capabilities of the ancient Egyptians. The Unfinished Obelisk provides information about highly efficient quarrying techniques, whereas the finished obelisks display evidence of the use of tools that were a mere ⅛ inch wide and were applied in a controlled way so as to leave sharp edges at the entrance point.

CHRONOLOGICAL PROGRESSION

Taking my six Wonders of Ancient Egypt in order of importance and applying their historical dates, it would appear that proficiency and skill spanned the entire timeline from the building of the Great Pyramid in the fourth dynasty to the crafting of the boxes in the Serapeum in the eighteenth dynasty, more than two thousand years later. The flat surfaces and square corners measured on the inside of the sarcophagus in Khafre's pyramid, for instance, are no different from the flat surfaces and square corners inside the boxes in the Serapeum. What distinguishes the two kinds of boxes is their size. Nonetheless, the evidence suggests that either the ancient Egyptians had developed a high level of precision early in their history and carried it forward through to the time of the Greeks and Romans or, as discussed in chapter 5, the

provenance of the site is so clouded with confusion that the dating of the granite boxes is affected by evidence left behind by later cultures. These giant boxes, for which there are no dating methods, may have resided in the tunnels for millennia—and without any inscription from the Ptolemaic period describing how the boxes were quarried, moved, and crafted to such a high order of precision; or evidence of tools and metrology instruments that reflect such precision; or machines that must have been used to create them, it is more than likely that they were created close to the same time as the pyramids, which also may have an earlier date of construction.

If I consider all the evidence within the same engineering context without regard to the time each example was built, I am compelled to suggest that the ancient Egyptians had to have used sophisticated machines that cut diorite and granite with little difficulty. The evidence suggests that they had lathes and that the lathes were built with precise bearings that regulated the rotation of the spindle. The contoured blocks on the Giza Plateau suggest that they had machines that cut exact, three-dimensional shapes on three axes.

The telltale marks on a Ramses head at Karnak and the indentation above the eyebrow suggest that a rectangular tool was directed along a precise path while oscillating at high frequency, like a jack hammer, against the surface. When the tool came to the eyebrow, it paused briefly, but the oscillations did not cease, and the tool cut deeper where it rested. Such signs are signatures of machining and are well-known consequences of allowing a tool to rest along its path while the cutting force is still applied. (This could be a lathe, for which the tool movement may stop but the work piece keeps rotating; or it could be a milling machine, for which the axes stop moving but the end mill continues turning.) Any machinist would recognize these marks.

The accidental grooves found in the statue of Amun and Mut in the Luxor Museum are proof of tools that do not exist in the archaeological record. These grooves provide evidence of rotary grinding wheels that were used to cut the fine details on the statues.

How were these tools guided? How was the symmetry of the Ramses

statues created? The tool marks plus the three-dimensional accuracy present clear evidence that only a precisely guided tool could produce these statues, and further, that the human hand cannot guide a tool with such precision. Today, we would use computer numerical controlled (CNC) machines. Fifty years ago, we would have created a model and controlled the movement of the machine with a stylus that followed the contours of the model. What technology was available to the ancient Egyptians?

It is significant to note that, excluding the boxes in the Serapeum and the interiors of the coffers in Kufu's and Khafre's pyramids, some of the precise artifacts I have studied and include in this book were not finished to a high level of polish. Nor do they have the striations caused by a rough abrasive that could have been used to achieve the exact geometries they demonstrate. Creating a surface to precise geometry, whether the geometry is flat-line or circular, if performed by hand work, would require spot finishing—that is, attending to areas that require the discreet removal of material to achieve their final, precise shape. It is surprising, therefore, to find surfaces that are finished to within 0.001 inch (0.0254 millimeter) that do not exhibit any signs of polish at all. Having produced precision surfaces by hand finishing and with machine-guided tools, when I examine surfaces created by the ancient Egyptians, it is clear to me that machines were involved in their creation.

Finally, there is the important question of precision. Chiseling and hand polishing a surface that compares to a surface produced by a modern machine when the object's purpose is to serve as an architectural element above a doorway, for example, does not make sense. It is completely unnecessary for the function it fills. The architectural elements found near the Valley Temple on the Giza Plateau and at the Temple of Denderah and other temples, however, *were* crafted by precise machine tools that produced precise products requiring no secondary finishing.

WHERE ARE THE MACHINES?

No machines have been found in the archaeological record to support these assertions, but there is an abundance of circumstantial evidence

that leads to such conclusions. Are the machines still intact and lying under the desert sand? Or were they removed completely from the areas? Or could it be that all of this evidence points to an earlier civilization that suffered a cataclysm of such magnitude that much of what existed was destroyed, and what remained was susceptible to erosion, decay, and corrosion, and slowly disappeared over a long period of time? This brings us back to Robert Schoch's evaluation of the erosion pattern on the Sphinx and the Sphinx enclosure. He claimed that the period of time when sufficient rain fell in Egypt to cause this erosion was seven to nine thousand years ago. Is this sufficient time for ancient machines to turn to dust and blow away? It seems incredible to imagine, but there is reason to suspect that this could have happened.

Pushing the history of the pyramids back in time is not a new concept. Stephen Mehler, in his book *Land of Osiris,* refers to his work with Abd'l Hakim Awyan, an Egyptian native who was considered a cultural wisdom keeper and has a lineage that can be traced back to predynastic Egyptians known as Khemitians. (Their homeland was known as Khemit—or KMT, given that ancient Khemitians did not use vowels in their language.) While it is only hearsay passed down through countless generations, the opinions of the elders should be considered, and Hakim's opinion on the age of the pyramids would have it pushed back even further than what Robert Schoch would support, given the geological evidence. Mehler writes: "When I first heard Hakim speak of the Sphinx in November 1992, he calmly asserted that she was over 52,000 years old."[4]

Stories of an older civilization have long been maintained in the traditions of indigenous peoples, who refer to them as a time when gods ruled the earth. This period in Egyptian lore is generally dismissed by Egyptologists as legend, and those who would propose such ideas, such as Schwaller de Lubicz and others, are considered New Age (in some circles a pejorative label) and are ignored. Yet there is mounting evidence and professional opinion that lead us to consider the old legends and take them more seriously. One example is the opinion of architect Dr. Hossam Abulfotouh, who maintains that the so-called workers' village

of Giza could not have been built by the same artisans who built the pyramids. We are left, therefore, to consider the idea of an older culture that was more gifted in architectural design and execution than has been commonly accepted. There is no question that the Great Pyramid is the most sophisticated and precise of all the structures on the Giza Plateau, and, frankly, of all the buildings in the world.

If we follow the idea of an older civilization, therefore, the pyramids would have already been there before the first dynasty of the ancient Egyptians. The Great Pyramid was, most likely, the zenith of construction on the plateau, and the other pyramids were likely built before it was. Yet something happened to the culture that built the pyramids, and when Khufu came on the scene, he naturally chose the most impressive structure—the Great Pyramid—as his own, and his heirs took turns in claiming the rest. What event could have brought death and destruction to this ancient civilization that is referred to in Egyptian lore as being inhabited by gods of the First Time?

As I concluded my research in Egypt, I pondered what might have driven the ancient Egyptians to devote their resources to such enormously difficult tasks, and I wondered how an advanced civilization would react if it had knowledge of impending doom. Perhaps it would turn its genius and industry into leaving a message that would survive the coming cataclysm and provide a technological imprint to say to future generations, "We were here. This is who we are and what we are capable of doing."

Modern society builds obsolescence into everything it makes. The ancient Egyptians may have spent their last days on earth building for eternity and preparing for the afterlife. They were obsessed with the afterlife. It was all that mattered to them. Is it not all that matters to us too? If so, then why do we wait until we are faced with our own mortality before giving it any attention? It seems that the continuity of generations provides us with a comforting belief in our immortality: a part of us will live on after we die. We are also comfortable leaving things for the next generation to fix or address. Yet if we knew that there would not be another generation, how would we behave? If we knew that a

day was coming when most of life on the planet would cease to exist, what kind of shock would that give our psyche? Earthly matters that normally consume our minds would surely be replaced with thoughts of the afterlife and how we would continue after we die.

Did the ancient Egyptians have knowledge of an impending catastrophe? Their marvelous spires of granite at Karnak were protected by walls, though we don't know if those walls were filled with sand or not. Why was it necessary to build a wall around Hatshepsut's obelisk? Many obelisks were not similarly protected, and some of them had fallen in prehistory. Massive statues, like those of Ramses at the Ramesseum, had toppled over at some time in prehistory. There was an event that devastated this civilization, and there are signs that they knew it was coming.

Mud brick walls were built around some structures. Some smaller statues now exhibited in the Luxor Museum were buried in the temple, and a scene on the ceiling of the Great Hypostyle Hall at Denderah describes the goddess Nut overarching and protecting the solar barques in procession through the heavens as they carry their dead through the Duat. Perhaps the Egyptians used their time left on the planet to cut deep into the hillside in the Valley of the Kings and create an extensive network of tunnels and chambers. Was KV5, the recently explored underground complex credited to Ramses II and his family, with its one hundred twenty-one chambers supposedly created for his sons (did he not have daughters?), actually built as an attempt to survive impending catastrophe and to continue the species?

The purpose of this book is not to answer these questions, but to propose possibilities based on the artifacts that are left. To question the historical account of ancient Egypt is disturbing to some. The responses to my previous writing on the subject have prompted me to present better evidence. I believe I have accomplished this here. Others will no doubt weigh in on the subject, and I am sure some will object to my conclusions.

Though the subject of the kinds of tools used by the ancient Egyptians to cut stone holds a continuing interest for many professionals

and laypeople alike, the debate has to move beyond the question of what cut the stones to an even more crucial question: What guided the tools? The amazing geometry and precision of ancient Egyptian artifacts cannot be lost in the debate about whether a coring tool left its mark as helical or horizontal grooves. Though resolving this question is important, it would not be as important without the massive amount of contemporaneous evidence that demands another thorough examination of our past. When we attempt to answer questions of how the ancient Egyptians created their monuments, the most difficult aspects of the work must be identified and replicated to the same form and precision as the originals.

Why is this important? For many people manufacturing precision is an abstract concept with which they have no personal involvement. Precision manufacturing demands strict adherence to a blueprint or engineering drawing. To replicate an object that is already made, it is necessary to make blueprints describing every characteristic of the object and to make sure that the copy of the original is the same.

We are surrounded by precise objects, which populate and shape our environment, but there was a time in history when this was not the case. In less time than the whole of ancient Egypt's fourth dynasty (2613–2494 BCE), the period of one hundred nineteen years, during which the Great Pyramid was supposedly built, civilization has moved from a predominantly manually intensive agrarian society in which the apprentice was unpaid and beholden to the master to learn his trade to one that trains schoolchildren how to live with technology so sophisticated and rapidly changing that often the children are called upon to teach their parents how to use it.

My background in precision machining has given me an enduring and profound respect for what this dizzying progress of knowledge and technology has brought to our society. Over the years, scores of engineers and craftspeople have contacted me to tell me they share my perspective. One such engineer is Steven Garcia from Chicago, who visited Egypt more than forty years ago. In one of my discussions with him, he complained to me that I was not assertive enough in my treatment of

ancient Egyptian artifacts and that I should be adamant that they could not have been produced without machines. Yet though I may not have been overly assertive in my beliefs on this subject, what I have written in the past has opened the debate. Since I started to publish my thoughts on this subject, I have continued to study the responses to my work as well as the evidence that has been offered to support the academic theories.

Taking into account all the foregoing evidence, I will assert now, unequivocally, that what has been found in the archaeological record and used by experimentalists must be dismissed as grossly inadequate to the task of producing the marvelous artifacts of ancient Egypt. What, however, do we replace them with? How were the Ramses statues crafted? How much time would it take a sculptor to create the 1,000-ton Colossi of Memnon? Or the 1,000-ton Ramses at the Ramesseum? Or the four colossal seated statues at Luxor?

Appearing on the base of the Ramesseum Ramses is a verse by the Greek historian, Diodorus Siculus: "King of Kings am I, Osymandias. If anyone would know how great I am and where I lie, let him surpass one of my works."

The challenge issued by Ramses to Diodorus Siculus in the first century BCE has not been met, but when it is fulfilled, Egypt's true manufacturing genius will be recognized and understood. When we consider a culture that created an array of artifacts that in their variety exhibit incredible size, symmetry, and precision in materials that even today are among the most difficult on earth to shape and move, and we know what could not have produced them, the mystery of ancient Egypt looms before us like a stupendous abyss between that astonishing time in human endeavor and our own. It beckons to us across the ages and demands that we are as exacting and uncompromising in our quest for answers as the Egyptians were in crafting the artifacts that confront us with the questions and the challenge: "What am I? How did I come to exist? Build another just like me."

Notes

INTRODUCTION

1. René Descartes, "Discourse on the Method of Rightly Conducting the Reason and Seeking for Truth in the Sciences," *Great Books of the Western World,* vol 31 (Chicago: William Benton, 1952), 47.

CHAPTER 1. THE SHADOWS OF LUXOR

1. R. A. Schwaller de Lubicz, *The Temple of Man* (Rochester, Vt.: Inner Traditions, 1998).
2. John Anthony West, *Serpent in the Sky: The High Wisdom of Ancient Egypt* (Wheaton, Ill.: Quest Books, 1993).
3. Edward Malkowski, *The Spiritual Technology of Ancient Egypt* (Rochester, Vt.: Inner Traditions, 2007).
4. See http://thinkexist.com/quotes/bruno_walter/ (accessed December 26, 2009).
5. R. A. Schwaller de Lubicz, *The Temple of Man*.

CHAPTER 2. THE SHADOWS OF RAMSES

1. See http://en.wikipedia.org/wiki/Fibonacci_number (accessed April 13, 2008).
2. Sixth century CE; See http://en.wikipedia.org/wiki/Indian_mathematics (accessed February 4, 2010).
3. R. A. Schwaller de Lubicz, *The Temple of Man*.
4. Ibid., 144.

5. "Why the Pyramids," www.egyptvoyager.com/aida_mainpage.htm (accessed February 4, 2010).
6. Michael Schneider, *A Beginner's Guide to Constructing the Universe: The Mathematical Archetypes of Nature, Art, and Science* (New York: Harper Collins, 1994), 241.

CHAPTER 3. THE RAMSES CHALLENGE

1. Isha Schwaller de Lubicz, *Her-Bak: The Living Face of Ancient Egypt,* quoted in "From the Outer Temple," www.duboislc.org/html/Proverbs.html (accessed February 4, 2010).
2. Evan Hadingham, "Unlocking the Mysteries of the Parthenon," *Smithsonian* (February 2008).

CHAPTER 4. THE SHADOWS OF KARNAK

1. Evan Hadingham, "Unlocking the Mysteries of the Parthenon," 39.
2. Denys A. Stocks, *Experiments in Archaeology: Stoneworking Technology in Ancient Egypt* (London: Routledge, 2003).
3. Nicholas Penny, *The Materials of Sculpture* (New Haven: Yale University Press, 1993), 21.
4. "Preserving Ancient Treasures Using Modern Technologies," www.world-mysteries.com/sci_3dm.htm (accessed December 16, 2009).

CHAPTER 5. THE SHADOWS OF THE SERAPEUM

1. Mohamed Ibrahim and David Rohl, "Apis and the Serapeum," *Journal of the Ancient Chronology Forum* 2 (1988): 10.
2. Strabo, *Geography,* Book XVII, 23, http://rbedrosian.com/Classic/Strabo17b.htm (accessed May 20, 2010).
3. Jimmy Dunn, "The Serapeum of Saqqara," www.touregypt.net/featurestories/serapeum.htm (accessed January 16, 2010), quotation of Auguste Mariette's *Le Serapeum de Memphis*.
4. Aidan Dodson, "The Eighteenth-Century Discovery of the Serapeum," *KMT* 11, no. 3 (Fall 2000): 50. (KMT is the ancient spelling for the name Khemit, which is the land that is now Egypt.)
5. Ibid., 52.
6. Mohamed Ibrahim and David Rohl, "Apis and the Serapeum," 14.
7. Personal communication with Eric Leither shortly after returning from Egypt in February 1995.

8. Hossam Abulfotouh, "Giza Plateau Mapping Project," *Newsletter of the UIA Work Program Architecture and Heritage, Region-V* 3, no. 1 (2006).

CHAPTER 6. THE SHADOW OF THE SPHINX

1. W. M. Flinders Petrie, *The Pyramids and Temples of Gizeh,* first ed. (London: Field and Tuer; New York: Scribner & Welford, 1883). Republished online at Ronald Birdsall, ed., "The Pyramids and Temples of Gizeh Online," www.ronaldbirdsall.com/gizeh (accessed February 4, 2010).
2. Christopher Dunn, "Advanced Machining in Ancient Egypt?" *Analog* (August 1984).
3. See www.quotes.net/quote/6148 (accessed January 17, 2009).
4. Ian Lawton and Chris Ogilvie-Herald, *Giza the Truth: The People, Politics & History Behind the World's Most Famous Archaeological Site* (London: Virgin Publishing, 1999).
5. W. M. Flinders Petrie, *The Pyramids and Temples of Gizeh,* first ed. (London: Field and Tuer; New York: Scribner & Welford, 1883).
6. Petrie, *The Pyramids and Temples of Gizeh,* 95
7. "Cutting Granite with Sand," www.pbs.org/wgbh/nova/lostempires/obelisk/cutting.html (accessed February 4, 2010).

CHAPTER 7. THE SHADOWS OF DENDERAH

1. Amelia Edwards, *A Thousand Miles up the Nile* (London: George Routledge and Sons, 1889), 120.
2. Mounir Basta, ed., "The Temple of Denderah," in *Simpkins Splendor of Egypt* (Salt Lake City: Simpkins Souvenirs, 1987).
3. Amelia Edwards, *A Thousand Miles up the Nile,* 112.

CHAPTER 8. STICKS AND STONES: TOOLS OF THE TRADE

1. I. E. S Edwards, "Pyramids: Building for Eternity," *Ancient Egypt: Discovering Its Splendors,* 73–101.
2. Denys A. Stocks, *Experiments in Archaeology: Stoneworking Technology in Ancient Egypt* (London: Routledge, 2003).

CHAPTER 9. IN THE SHADOW OF AN OBELISK

1. Miriam Lichtheim, *Ancient Egyptian Literature, Volume II,* 28.
2. Mark Lehner, et al., *Secrets of Lost Empires: Obelisk,* directed by Michael Barnes, *Nova* (PBS), February 12, 1997. See www.pbs.org/wgbh/nova/transcripts/2405obelisk.html (accessed December 16, 2009).

3. Ibid.
4. Denys A. Stocks, *Experiments in Archaeology: Stoneworking Technology in Ancient Egypt,* 64, 65.
5. Peter Tyson, *Secrets of Lost Empires: Obelisk,* directed by Michael Barnes, *Nova* (PBS), February 12, 1997, see www.pbs.org/wgbh/nova/egypt/team/rashwan.html (accessed February 4, 2010).
6. Ibid.
7. Reginald Engelbach, *The Problem of the Obelisks* (New York: George H. Doran Company, 1923), 20–21.
8. Ibid., 25.
9. Ibid., 48.
10. Doug Kenyon, *Forbidden History,* 256–62.
11. R. Engelbach, *The Problem of the Obelisks,* 42.
12. Ibid., 104.
13. Ibid., 48.
14. Ibid., 49.

CHAPTER 10. IN THE SHADOW OF EGYPTIAN MEGAMACHINES

1. See http://thinkexist.com/quotes/dante_alighieri/2.html (accessed February 4, 2010).
2. Stephen S. Mehler, *The Land of Osiris* (Kempton, Ill.: Adventures Unlimited Press, 2001).
3. Stephen S. Mehler, *From Light into Darkness: The Evolution of Religion in Ancient Egypt* (Kempton, Ill.: Adventures Unlimited Press, 2005).
4. Stephen S. Mehler, *The Land of Osiris,* 125–26.
5. See http://egyptsites.wordpress.com/2009/02/27/the-pyramid-of-djedefre-at-abu-Roash/ (accessed January 6, 2010).
6. Peter Lu, "Early Precision Compound Machine from Ancient China," *Science* 304 (June 11, 2004): 1638.
7. William Flinders Petrie, *The Pyramids and Temples of Gizeh* (London: Field & Tuer; New York: Scribner & Welford, 1883), 75.
8. Petrie, *The Pyramids and Temples of Gizeh,* 75, 76.
9. Robert G. Moores Jr., "Evidence for Use of a Stone-Cutting Drag Saw by the Fourth Dynasty Egyptians," *Journal of the American Research Center in Egypt* 28 (1991): 146.
10. Ibid., 141.
11. Ibid., 143.
12. Ibid.

13. Ibid., 148.
14. Ibid., 147.
15. Ibid., 148.
16. Denys A. Stocks, "Testing Ancient Egyptian Granite-working Methods in Aswan, Upper Egypt," *Antiquity* 75 (2001): 90.
17. Ibid.
18. Ibid.
19. See www.freepatentsonline.com/7082939.html (accessed April 18, 2009).
20. Robert G. Moores Jr., "Evidence for Use of a Stone-Cutting Drag Saw by the Fourth Dynasty Egyptians," 148.
21. Denys A. Stocks, "Testing Ancient Egyptian Granite-working Methods in Aswan, Upper Egypt," 90.
22. Mark Lehner, *The Complete Pyramids: Solving the Ancient Mysteries,* 120–21.

CHAPTER 11. WALKING IN THE SHADOW OF WILLIAM F. PETRIE

1. Comment by Mark Lehner at the American Association for the Advancement of Science Convention in Chicago, 1992.
2. Eric P. Uphill, "A Bibliography of Sir William Matthew Flinders Petrie (1853–1942)," *Journal of Near Eastern Studies* 31, no. 4 (Oct., 1972): 356–79, www.jstor.org/pss/543795 (accessed February 5, 2010).
3. "Scholars Dispute Claim that Sphinx Is Much Older," *New York Times,* February 9, 1992, www.nytimes.com/1992/02/09/us/scholars-dispute-claim-that-sphinx-is-much-older.html (accessed April 25, 2009).
4. Ibid.
5. Henry Hodges, *Technology in the Ancient World* (New York: Barnes and Noble Books, 1970), 185.
6. William Flinders Petrie, *The Pyramids and Temples of Gizeh,* 77–78.
7. Ibid., 74–75.
8. Christopher Dunn. "Advanced Machining in Ancient Egypt?" *Analog* CIV, no. 8 (August 1984): 67–82.
9. William Flinders Petrie, *The Pyramids and Temples of Gizeh,* 75–77.
10. Denys A. Stocks, "Technology Innovators of Ancient Egypt," *Ancient Egypt* 7, no 3 (December/January 2007).
11. Deiter Arnold, *Building in Egypt: Pharaonic Stone Masonry* (New York: Oxford University Press, 1991), 266, 268, n64.
12. Denys A. Stocks, "Testing Ancient Egyptian Granite-working Methods in Aswan, Upper Egypt," *Antiquity* 75 (2001): 93.

13. Denys A. Stocks, *Experiments in Archaeology: Stoneworking Technology in Ancient Egypt* (London: Routledge, 2003), 135.
14. A. Lucas and J. R. Harris, *Ancient Egyptian Materials and Industries* (New York: Dover Publications, 1999), 70–71.
15. Denys A. Stocks, *Experiments in Archaeology,* 128.
16. Leonard Gorelick and A. John Gwinnet, "Philological and Archaeological Evidence for the Use of Emery in the Bronze Age Near East," *Journal of Cuneiform Studies* 40, no. 2 (Autumn, 1988): 195–210, www.jstor.org/stable/1359662 (accessed January 11, 2010).
17. Ian Lawton and Chris Ogilvie-Herald, *Giza the Truth: The People, Politics & History Behind the World's Most Famous Archaeological Site,* 217.
18. W. F. M. Petrie, "On the Mechanical Methods of the Ancient Egyptians," *Journal of the Anthropological Institute of Great Britain and Ireland* 13 (1884): 90.
19. Ian Lawton and Chris Ogilvie-Herald, *Giza the Truth: The People, Politics & History Behind the World's Most Famous Archaeological Site,* 217.
20. W. F. M. Petrie, "On the Mechanical Methods of the Ancient Egyptians," *Journal of the Anthropological Institute of Great Britain and Ireland* 13 (1884): 103, 104.
21. Ibid., 104.
22. Ibid.

CHAPTER 12. SUSPENDING DISBELIEF

1. Chiselwa Kawanda, "Mosi-oa-Tunya: The Smoke that Thunders," Sunday Times of Zambia, www.times.co.zm/news/viewnews.cgi?category=8&id=1186648182 (accessed February 11, 2010).
2. New 7 Wonders, "The Pyramids of Giza (2600–2500 B.C.), Egypt," www.new7wonders.com/classic/en/n7w/finalists/c/PyramidsofGiza/ (accessed May 9, 2009).
3. R. A. Schwaller de Lubicz, *The Temple of Man.*
4. Stephen Mehler, *The Land Of Osiris,* 116.

Selected Bibliography

Arnold, Dieter. *Building in Egypt.* New York: Oxford University Press, 1991.

Clarke, Somers, and R. Engelbach. *Ancient Egyptian Construction and Architecture.* New York: Dover Publications, 1990.

Curran, Brian A., Anthony Grafton, Pamela O. Long, and Benjamin Weiss. *Obelisk: A History.* Cambridge, Mass.: The Burndy Library, 2009.

de Lubicz, R. A. Schwaller. *The Temple of Man.* Rochester, Vt.: Inner Traditions, 1998.

———. *The Temple of Karnak.* Rochester, Vt.: Inner Traditions, 1999.

Descartes, René. "Discourse of Rightly Conducting the Reason and Seeking for Truth in the Sciences." *Great Books of the Western World,* vol 31. Chicago: William Benton, Encyclopædia Britannica, 1952.

Dunn, Christopher. "Advanced Machining in Ancient Egypt?" *Analog* CIV, no. 8 (August 1984): 67–82.

———. *The Giza Power Plant: Technologies of Ancient Egypt.* Rochester, Vt.: Bear and Company, 1998.

Edwards, Amelia B. *A Thousand Miles up the Nile.* London: George Routledge and Sons, 1889.

———. *Pharaohs, Fellahs and Explorers.* New York: Harper and Brothers, Franklin Square, 1891.

Edwards, I. E. S. "Pyramids: Building for Eternity." *Ancient Egypt: Discovering Its Splendors.* New York: National Geographic Society, 1978.

Emerson, Ralph W. *Emerson's Essays, First and Second Series.* New York: Thomas Y. Crowell Company, 1926.

Engelbach, R. *The Problem of the Obelisks.* New York: George H. Doran Company, 1923.

Flinders Petrie, Sir William M. "On the Mechanical Methods of the Ancient Egyptians." *Journal of the Anthropological Institute* (1884).

———. *Ten Years Digging in Egypt.* Chicago: Ares Publishers, 1976.

———. *The Pyramids and Temples of Gizeh.* London: Field and Tuer, 1883. Reprinted with an update by Dr. Zahi Hawass. London: Histories and Mysteries of Man LTD., 1990.

Hadingham, Evan. "Unlocking the Mysteries of the Parthenon." *Smithsonian* (February 2008).

Hodges, Henry. *Technology in the Ancient World.* New York: Barnes and Noble Books, 1970.

Kenyon, Doug. *Forbidden History*. Rochester, Vt.: Bear & Company, 2006.

Lawton, Ian, and Chris Ogilvie-Herald. *Giza the Truth: The People, Politics & History Behind the World's Most Famous Archaeological Site.* London: Virgin Publishing, 1999.

Lehner, Mark. *The Complete Pyramids: Solving the Ancient Mysteries.* London: Thames and Hudson, 1997.

Lehner, Mark, et al. *Secrets of Lost Empires: Obelisk*. Directed by Michael Barnes. *Nova,* PBS, February 12, 1997.

Lehner, Mark, et al. *Secrets of Lost Empires: Pharaoh's Obelisk*. Directed by Michael Barnes. *Nova,* PBS, February 8, 2000.

Lichtheim, Miriam. *Ancient Egyptian Literature: Volume II, The New Kingdom*. Berkeley: The University of California Press, 1976, 2006.

Lu, Peter. "Early Precision Compound Machine from Ancient China." *Science* 304 (June 11, 2004): 1638.

Lucas A., and J. R. Harris. *Ancient Egyptian Materials and Industries.* New York: Dover Publications, 1999.

Malkowski, Edward. *Spiritual Technology: Sacred Science and the Mystery of Consciousness.* Rochester, Vt.: Inner Traditions, 2007.

Mehler, Stephen S. *From Light into Darkness: The Evolution of Religion in Ancient Egypt.* Kempton, Ill.: Adventures Unlimited Press, 2005.

———. *The Land of Osiris.* Kempton, Ill.: Adventures Unlimited Press, 2001.

Mertz, Barbara. *Temples, Tombs & Hieroglyphs: A Popular History of Ancient Egypt.* New York: William Morrow, 2007.

Moores, Robert G. "Evidence for Use of a Stone-Cutting Saw by the Fourth Dynasty Egyptians." *Journal of the American Research Center in Egypt* 28 (1991): 139–48.

Noblecourt, Christiane Desroches. *Ramses II.* Paris: Flammarion, 2007.

Oakes, Lorna, and Lucia Gahlin. *Ancient Egypt: An Illustrated Reference to the*

Myths, Religions, Pyramids and Temples of the Land of the Pharaohs. New York: Barnes and Noble Books, 2006.

Penny, Nicholas. *The Materials of Sculpture.* New Haven: Yale University Press, 1993.

Schmidt, Stanley. *Analog Essays on Science.* New York: John Wiley and Sons, 1990.

Schneider, Michael S. *A Beginner's Guide to Constructing the Universe: The Mathematical Archetypes of Nature, Art, and Science.* New York: Harper Collins, 1995.

"Scholars Dispute Claim That Sphinx Is Much Older." *New York Times,* February 9, 1992, available at www.nytimes.com/1992/02/09/us/scholars-dispute-claim-that-sphinx-is-much-older.html.

Shaw, Ian, ed. *The Oxford History of Ancient Egypt.* New York: Oxford University Press, 2000.

Stocks, Denys A. *Experiments in Archaeology: Stoneworking Technology in Ancient Egypt.* London: Routledge, 2003.

———. "Technology Innovators of Ancient Egypt." *Ancient Egypt Magazine* 7, no. 3, Issue 39 (2007): 37–43.

———. "Testing Ancient Egyptian Granite-working Methods in Aswan, Upper Egypt." *Antiquity* 75 (2001): 89–94.

Tompkins, Peter. *The Magic of Obelisks.* New York: Harper and Row, 1981.

West, John Anthony. *Serpent in the Sky: The High Wisdom of Ancient Egypt.* Wheaton, Ill.: Quest Books, 1993.

Wilkinson, Richard H. *Reading Egyptian Art: A Hieroglyphic Guide to Ancient Egyptian Painting and Sculpture.* London: Thames and Hudson Ltd., 1992.

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From the pyramids in the north to the temples in the south, ancient artisans left their marks all over Egypt, unique marks that reveal craftsmanship we would be hard pressed to duplicate today. Drawing together the results of more than 30 years of research and nine field study journeys to Egypt, Christopher Dunn presents a stunning stone-by-stone analysis of key Egyptian monuments, including the statue of Ramses II at Luxor and the fallen crowns that lay at its feet. His modern-day engineering expertise provides a unique view into the sophisticated technology used to create these famous monuments in prehistoric times.

Using digital photography, computer-aided design software, and metrology instruments, Dunn exposes the extreme precision of these monuments and the type of advanced manufacturing expertise necessary to produce them. His computer analysis of the many statues of Ramses II reveals that the left and right sides of the faces are precise mirror images of each other, and his examination of the mysterious underground tunnels of the Serapeum illuminates the finest examples of precision engineering on the planet. Providing never-before-seen evidence in the form of more than 280 photographs, Dunn's research shows that while absent from the archaeological record, highly refined tools, techniques, and even megamachines must have been used in ancient Egypt.

CHRISTOPHER DUNN is a manufacturing engineer with 50 years of experience. He has worked primarily in aerospace with an emphasis on precision and laser application. He has published a dozen articles on his theories about ancient technology and is the author of *The Giza Power Plant*. He lives in Illinois.

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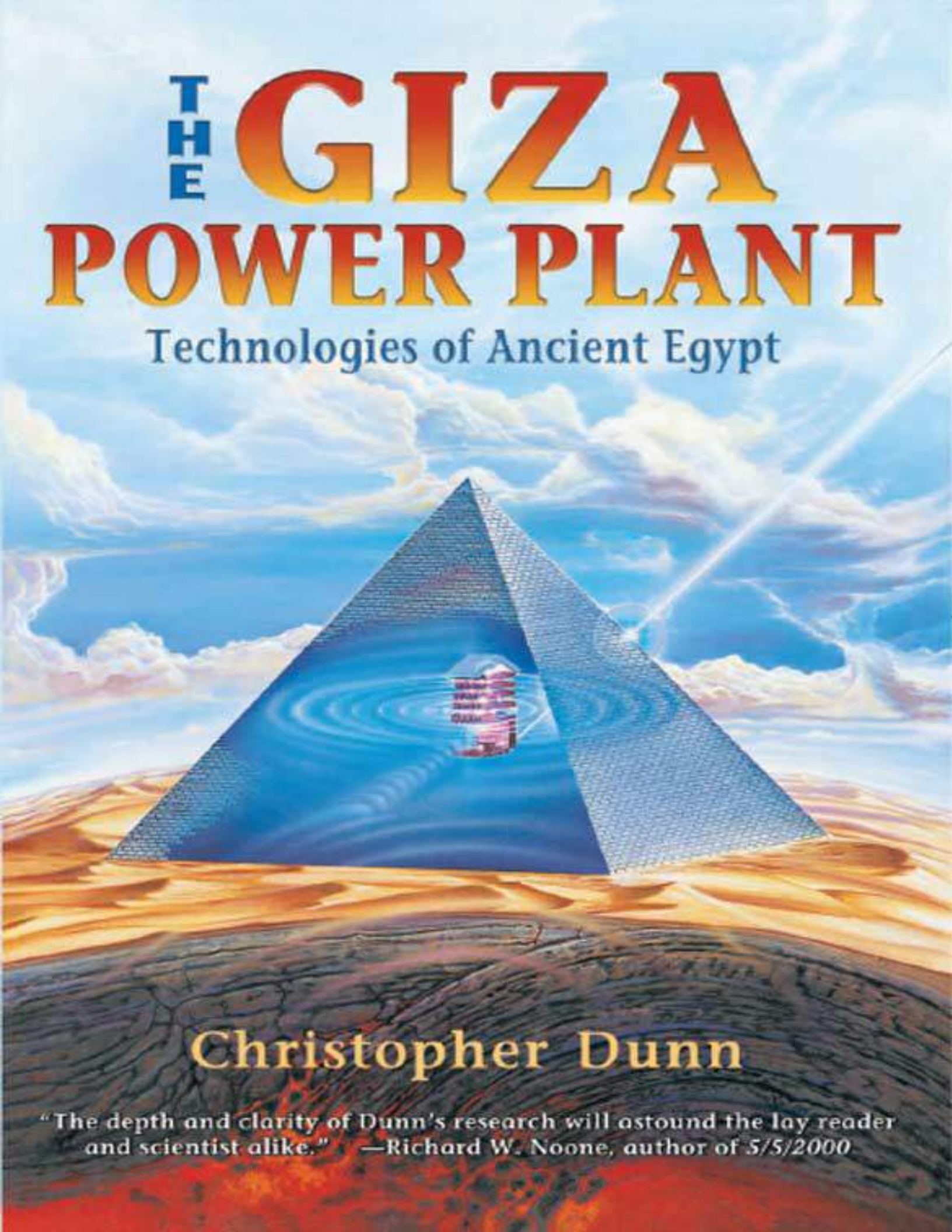
THE GIZA POWER PLANT

Technologies of Ancient Egypt



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"The depth and clarity of Dunn's research will astound the lay reader and scientist alike." —Richard W. Noone, author of *5/5/2000*

THE GIZA POWER PLANT

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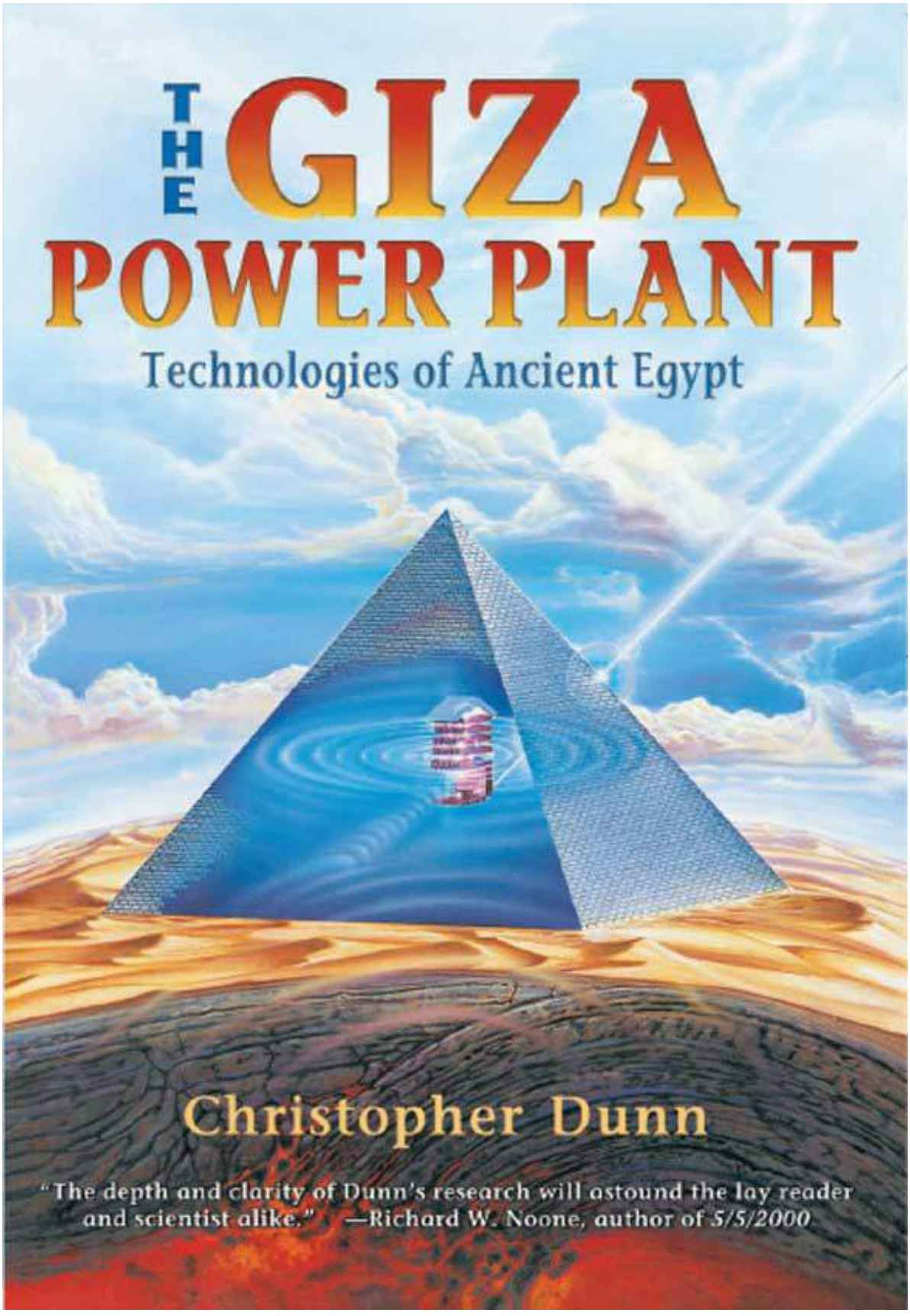

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"The depth and clarity of Dunn's research will astound the lay reader and scientist alike." —Richard W. Noone, author of *5/5/2000*

The GIZA POWER PLANT

Bear & Company
Rochester, Vermont

DEDICATION

To Jeanne, Peter, Alexander, Geno, my parents, and my European family and friends.

The GIZA POWER PLANT

"Chris Dunn ranks among the top researchers in this subject. His book is extremely well researched and presented and, although very controversial in content and conclusions, will no doubt become a landmark and classic in the field of pyramid studies. Dunn deserves the recognition and respect he is bound to receive for his tenacity, his meticulous presentation and, above all, his daring and innovative ideas."

—Robert G. Bauval, coauthor of *The Orion Mystery*

"None of the previous theories regarding the purpose of the Great Pyramid really explain the known facts. From the tombs for the pharaohs, to markers for astrology, every explanation, thus far, has failed to account satisfactorily for at least some aspect of the physical evidence. Christopher Dunn, however, has looked squarely at all available research and provided a truly convincing and scientific, albeit revolutionary, explanation in *The Giza Power Plant."*

—Douglas Kenyon, editor of *Atlantis Rising*

ACKNOWLEDGMENTS

A single name is on the cover of this book because there is not room for each person who should get credit for the work contained within. Ever since I was able to read, I have held authors in high esteem. In fact, I am awestruck by them. Rarely, though, did I read their acknowledgments page, and when I did I did not fully appreciate the importance of the author's credits. Now I do. I now realize that in order to make a book possible, an author needs mountains of support from family, friends, colleagues, and ultimately the editors who guide the rough manuscript to book form. Now that this book is in your hand, and I have joined the ranks of authors, I am humbled by the process that has brought me here, and would like to place credit where it belongs.

Without the support of my family, this book would not be possible. The untold hours on the computer, while chores and family time were put on hold, could only have been spent with the full support and kind patience of my wife, Jeanne. Even before the manuscript found a publisher, Jeanne spent many hours on the old manuscript, which had been started in 1977 and had not been worked on since 1983, creating an electronic copy and fixing my grammar and punctuation. The enthusiasm of my children, who write proudly in their school essays that "Father is an engineer and author," has surprised and delighted me.

Though we have never met, and have only talked on the telephone for a few minutes, I have spent many hours with Peter Tompkins, via his book *Secrets of the Great Pyramid.* Without his efforts in making early research on the Great Pyramid available in a descriptive and readable way, *The Giza Power Plant* would not have been given life.

I started *The Giza Power Plant* in 1977. I gave it the title on the day of its genesis and it will be of age in September 1998. Over the past twenty-one years, I have received guidance, information, advice, and encouragement from many people from all walks of life. Without Paul and Ardith Keller of Camby, Indiana, the work would not have even started. They helped me

change my perspective on my life, my spirit, and my soul-they made it possible for me to imagine the unimaginable. I would also like to thank Lexey Ann for introducing me to them.

I would like to thank my dear friends Arlan and Joyce Andrews, who goaded me into submitting parts of my book for publication in magazines—on more than one occasion—and for presenting me with a talented foil against which I honed my ideas. Thanks also to Dr. Stanley Schmidt of *Analog* magazine for seeing the value of "Advanced Machining in Ancient Egypt" and seeing fit to publish it on two occasions, and to Jeff D. Kooistra, for reading *The Giza Power Plant* synopsis and adding his own perspective on Tesla technology.

I greatly appreciate my dear friends, Jeff and Judie Summers, who have given me encouragement and support in many different ways; and Tom Adams, Steven Defenbaugh, Joe Drejewski, Arlen Gondry, Joe Klinger, Dr. Katherine Klinger, Judd Peck, Donald Raha, Max Rettig, Clyde Treadwell, and my friends at the Danville Engineers Club.

In the past three years I have been fortunate to meet other researchers who question orthodox beliefs and who are working tirelessly to bring enlightenment and truth to the world. Each brings a different perspective on ancient cultures, and, while we do not necessarily all agree on every aspect, I have been amazed at the high level of cooperation and support shown by Robert Bauval, Mike Brass of the University of Capetown, South Africa, David Hatcher Childress, James Hagan, Graham Hancock, and Roger Hopkins; Laura Lee, Eric Leither, Robert McKenty, Stephen Mehler, Tom Miller, and Richard Noone; Chris Ogilvie, Roel Oostra, Dr. Robert Schoch, Robert Vawter, John Anthony West, and Colin Wilson. I also appreciate those who have sent me e-mails after reading my article on the Internet. They are too numerous to mention, but should know that I appreciate their comments and support. I also appreciate those who have challenged my ideas, for I find that these challenges are great opportunities for growth and learning. A debate on ('Advanced Machining in Ancient Egypt" raged for almost six months on the sci.archaeology newsgroup, and was brought to my attention by Rodney Small, who had read the original article in 1984. I would like to thank the principal debaters on this issue, Miguel Magguire, August Matthusson, and Martin Stower, for their most eloquent and scholarly

contribution. It was August who kept pounding on the question, "Where are the power plants?"

J. Douglas Kenyon, editor of *Atlantis Rising,* is largely responsible for bringing contact between me and Barbara Clow of Bear & Company. Barbara tore apart a manuscript that had been lying dormant for so many years that it had calcified. After I submitted it three times, feeling as though I had been brought to the front of the class each time, she finally agreed that it should go to copyediting. Little did I know at this point that the real work was to begin; I cannot thank Joan Parisi Wilcox enough for holding my feet to the fire and the effort she put into the manuscript in making it what it is now. I appreciate her scholarship, her original skepticism, and her subsequent belief in the radical theory *The Giza Power Plant* proposes. Many thanks also to editorial director, John Nelson; publicity director, Jody Winters; and the rest of the Bear clan who make this book possible.

And to the people of the United States of America, who have created an environment that nurtures freedom, creativity, and opportunity. As an immigrant, I fully recognize the benefits this environment has given me.

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INTRODUCTION

For years there has been a strong belief that a highly advanced civilization populated this planet thousands of years ago. This belief seems to be increasing and affecting not just the fringes of academic thought, but as the new millennium approaches, more conventional scholars and their students. Anomalous artifacts have been found in Egypt and other places that imply the use of what we would consider advanced technology, by either their function or design and manufacture. Did our distant ancestors possess scientific knowledge and technical skills that we have struggled to acquire for centuries? Many people would emphatically answer "Yes"! Based on logical arguments that reference artifacts from ancient times, scholars and laypeople alike are slowly coming to the realization and giving credence to the idea that cataclysmic forces brought a technologically astute civilization to an end.

Understandably, this movement, which threatens to shake the foundations of Western orthodoxy, has its antagonists. And in rebutting speculations about the existence of technologically advanced civilizations in prehistory, orthodox scholars pose pertinent questions: Where is the infrastructure to support such a high civilization? How was this culture sustained? Where are their power lines? Where are their power plants?

The engineering marvel of Egypt known as the Great Pyramid of Giza provides some answers to these questions. Its sheer size and precision have evoked amazement and wonder from people of all disciplines who for decades have studied and tried to understand what it would take to duplicate it. Moreover, it has prompted people to question and wonder about the nature of its true origins—indeed, about the true purpose for which it was originally built.

Why should this be? Hasn't it been proven that the Great Pyramid was originally a tomb? Well, it depends on whom you believe. Certainly scholars have theorized that the Great Pyramid was built to be a tomb, but their

questioning and inquiries have continued for decades without ceasing, and the views of many are that the theory is not supported by evidence. In this book, I will evaluate and present evidence that refutes the tomb theory and that shows instead that the Great Pyramid of Giza is in fact an amazing—and technically advanced—machine.

The Great Pyramid has dominated the Giza Plateau for thousands of years; and during those years it has attracted the attention of millions by its profound ability to puzzle, confound, amaze, and defy the questioning minds of generations of scholars. In the chronology of serious studies of the Great Pyramid, there has been so much wonderment, superstition, speculation, and religious awe directed toward it that it is sometimes difficult to view this structure without one of these emotions coloring one's perspective. Enormous amounts of data have been amassed about this pyramid, and much of it still requires analysis. Ultimately, researchers have had to leave the subject without completely answering all the questions. The following two quotations aptly express the dilemma faced by anyone trying to understand the true significance of the Great Pyramid. In *Secrets of the Great Pyramid,* Peter Tompkins wrote, "I have collected a mass of numerical evidence which shows that the inhabitants of the ancient world were acquainted with the rate of the precession of the equinoxes and attached a major significance to it. But in order to deal with this evidence, I would have to open an entirely new topic. I beg the indulgence of the reader in asking him to remain satisfied for the moment with the mere hint that there is yet another lesson about the level of Egyptian science to be drawn from the stark nakedness of the Great Pyramid."[1] William Fix, in *Pyramid Odyssey,* said, "Making sense of the Great Pyramid and the information encoded in it requires a fundamental re-visioning of history and the nature of man."[2]

One night in September 1977, I was engrossed in Tompkins' book, and his ideas, and those of numerous other researchers, that the Great Pyramid was more than just a tomb, resonated within me like rolling thunder. Thunder touches everything in its path, but to understand it, you have to penetrate a heavy cloak of clouds. I felt as though I was penetrating those clouds. The technologist in me was awakening to a voice that leapt from the pages and demanded attention. I became fascinated with a topic about which I had little prior information or interest. My life was changed.

Encyclopedias contained little of the data that Tompkins' book provided. His predominant focus was the Great Pyramid, and he presented theories of numerous researchers dating back to the time of Herodotus. There was a distinct presumption on the part of many that certain characteristics of the Great Pyramid did not fit the expectations one would have for a burial place. Not wanting to stray too far from the "official" theory, some assigned a dual purpose to it. Others questioned the validity of the tomb scenario and offered other ideas to supplant it. Using photographs, sketches of the inner passages and chambers of the Great Pyramid, and measurements carefully taken by nineteenth-century explorers, Tompkins presented details describing a relic from the Old Kingdom in Egypt that, when examined in the context of an undeveloped society, stood out in stark contradiction to traditional views of the building and purpose of the Great Pyramid. Moreover, the accurate detail and precision with which the Great Pyramid was built were clearly very advanced, even when compared to the efforts of modern technologists such as myself.

In my mind, Tompkins' questions were persuasive arguments for further study of the Great Pyramid, and they launched me on an individual quest to evaluate the data myself. I was driven by the question: If the Great Pyramid is not a tomb, then what is it? A large part of my background has been studying blueprints and understanding the intentions of the engineers and drafts people who created them. Studying the drawings that showed a cross section of the Great Pyramid and reading about the astounding precision built into it, I was astonished and could find no logical resemblance to any feature one would find in a building constructed for human activity. Precise descriptions of almost every inch of the Great Pyramid revealed an accuracy and detail on such a large scale that I began to question that the Great Pyramid was used as a tomb.

I began to see the drawings of the Great Pyramid, with its numerous chambers and passageways positioned with such deliberate accuracy, as the schematics of a very large machine. I became convinced that it could not be anything else, and I set about trying to understand how this machine operated. The effort could be considered similar to what is known as the process of reverse engineering. To be successful at this, I knew that I had to find an answer for every single detail found within the Great Pyramid. I could

not ignore any evidence or twist it in any way. I was determined to prepare a report that was accurate and as honest as I was capable of making it.

As a craftsman and engineer, I have worked with machines for over thirty-five years. I began to apply my specialized knowledge to the data gathered about the Great Pyramid. For instance, scholars have suggested that the pyramids were built with primitive hand tools. This is a subject I know something about. I once apprenticed in England, where I worked many hours using nothing but hand tools. Saws, drills, files, and chisels were all we were allowed to use to create precision objects. At the time, I failed to see the benefit of this toil Why work eight hours a day bent over a piece of steel clamped in a vise when there was machinery in the area that would do the work more quickly and accurately? The result of this labor was several precision artifacts and—more important—the knowledge and appreciation of what it takes to produce something by hand. It also served to forge continuity between the craftspeople of the Old World and those of the New World. As I evaluated the opinions of Egyptologists about ancient building and machining techniques, my training told me that their theories were lacking at best—and outright wrong at worst. As I looked at the data, in fact, I began to suspect that the ancient Egyptians may have used technologically advanced tools.

Bringing applications from my work as a machinist to bear on my speculations about Egypt and its Great Pyramid, this vague suspicion became a firm belief as I pondered for innumerable hours on the methods that might have been used to produce the various artifacts. I was filled with awe and wonder at the techniques used, and at the same time I began to be aware of a greater appreciation for the technology our own society has developed. I also wondered what future archaeologists would say about some of the artifacts we may leave behind.

With the advances in manufacturing technology, my career has been a continuous educational experience that ultimately guided me into the field of laser processing of materials. During this period, I was asked to give a presentation to a local high school on career opportunities in manufacturing. In preparation for my presentation, I cut two identical cartoon characters out of stainless steel on as-axes YAG laser. The machine is a computer numerical controlled machine, and each character had fine detailing with a .010-inch kerf (cut width).

Having a fascination for the analytical skills necessary to determine how prehistoric societies manufactured precision artifacts, I presented one of these laser-cut figures to the class and told them that if our civilization were to be destroyed, future archaeologists may be able to determine the manufacturing tools our civilization uses just by studying that object. The surface of the cut, when studied under a microscope, would show signs of a recast layer, indicating the use of heat in its production, and the fine kerf can only be produced by that heat being focused to a very small spot. The laser, I explained to the class, is the only method that is capable of producing the features found in this object. I then described the various disciplines involved in the creation of the laser. It required physicists, optical engineers, mechanical engineers, materials and electrical engineers, and a host of crafts people building equipment to their specifications. There were quite a few careers involved in the creation of this seemingly simple cartoon character.

To envision this laser-cut object, think of a talented artist drawing freehand with a pencil. The lines where the laser has cut through the material are as thick as a pencil line. Using the law of Occam's razor, where the simplest solution is probably the correct one, it could be assumed that a talented artist created this stainless steel character by guiding a handheld laser. I then produced the other cartoon character and placed them together so that each feature overlaid the other perfectly. Now, I told the class, because the human hand and eye are incapable of producing two objects that have complex features with such precision, the scope broadens. There were obviously other disciplines and careers that had a hand in the cutout. There had to have been some mechanical device to guide the laser along its path. There had to have been controls to turn the laser off—as it passed over the metal—and on again to punch a hole through the metal and begin once again cutting the intricate lines. We need electronics engineers, machine tool designers and builders, and computer engineers and programmers, I explained, to build the computers and write the codes that guide the machine tool and control the laser. Besides introducing the class to the hidden work opportunities that are behind the most simple artifacts, my point was to teach the students that a tool is neither created or used in isolation. What I did not tell them was that the same analytical skills and analyses that are readily accepted when applied to modern artifacts can be equally beneficial when analyzing artifacts from

ancient times. The difference is that the tools that created modern artifacts are still in existence, while those that created many ancient artifacts are not.

It has been the practice of archaeologists to study the artifacts of a civilization and determine the minimum resources necessary to create them. Generally the primitive tools archaeologists uncover are sufficient to explain these artifacts. There are exceptions, however; and Egypt has an abundance of artifacts that still need to be evaluated correctly. Attempts have been made to explain some of these artifacts, but they fall short of determining how we could actually re-create the artifacts themselves. Part of this problem among academics is a persistent barrier in their beliefs which has resulted in their unwillingness to consider ancient civilizations as being advanced. It is my contention that until scholars select the methods that accurately replicate some of these artifacts under study, they will continue to underestimate ancient achievements and fail to learn their true significance.

Because so many Egyptian artifacts, including the Great Pyramid itself, cannot be explained adequately or fully by anyone theory, the field of Egyptology is rife with controversy and speculation. There is no shortage of theories regarding the construction and meaning of the Great Pyramid—and the believers of a particular theory have a tendency to hold it passionately and religiously. In order to present my own view, I will address other theories and identify where they fall short. My purpose, however, is to promote cooperation between multidisciplined researchers in the quest for knowledge about our prehistoric ancestors. No single discipline is capable of analyzing and presenting the entire truth regarding the Great Pyramid. It requires experts from many different fields. And Egyptology is only one of them. The fact is that from laypeople to senior research scientists, the old theories are being rejected, and there are new views being presented by researchers with expertise in various fields. While faced with criticism and sometimes derision for their ideas, these new, often independent, theorists possess a high level of cooperation and dedication to the truth. For example, Robert Bauval, author of *The Orion Mystery,* has these qualities. His discovery of the stellar alignment of the Giza pyramids with the constellation Orion is a valuable lesson that challenges us to reconsider both the Great Pyramid's function and the ancient Egyptians' level of astronomical knowledge. Other independent researchers such as Graham Hancock, John Anthony West, and Robert

Schoch have supported and energetically promoted the airing of views different from their own because they believe that each contributor to this research could bring a vital clue in our understanding of this ancient culture.

This new understanding is important to us as a species for it supplies us with a history that is deeper and richer than we previously thought. At the same time, it provides us with a guidepost to a future that combines the best of both worlds—blending the technology of the present with the technology of a past that we are only now rediscovering. And perhaps more important, this new understanding will reveal a thread of consciousness that is connected with our distant ancestors, giving us a new perspective and sense of mortality.

Chapter One

A NEW PARADIGM, A NEW ORDER

There is excitement in the air, and the Internet is buzzing. There is something going on in Egypt. There is intense anticipation that new discoveries and a tremendous amount of information are about to be uncovered. Why all this interest in the relics of an ancient civilization that flourished in an area of the world so removed from our own? Egypt has always had the power to attract and mystify. To visit Egypt and enter the massive stone edifices still standing after eons is to be drawn into a spell that has been wielding its influence for millennia. What is going on at Giza? What revelations regarding prehistory are now forthcoming?

Most information related to ancient Egypt has been in the control of Egyptologists, and it has typically been their research and discoveries that have held authority over all others. Egyptian Egyptologist Zahi Hawass, the director of the Giza Plateau, recognizes that Egypt is in possession of archaeological sites that are the intellectual property of the world. At the same time, the pyramids and the Sphinx are valuable sources of income for Egypt from tourism and archaeological permits.

In recent times, expert opinions—other than Egyptologists'—have been solicited regarding the relics of Egypt. For example, during a recent exploration on the Giza Plateau funded by Dr. Joseph Schor, an engineer was invited to participate in a search for the Hall of Records, which Edgar Cayce predicted was underground near the Great Sphinx. Tom Danley, an acoustics engineer and consultant to NASA, also conducted resonance tests inside and above the King's Chamber in the Great Pyramid. The results of his tests are remarkable and will be addressed later in the book.

The summer of 1997 was filled with reports of clandestine digging inside the Great Pyramid. Eyewitnesses testified that fresh tunnels were being dug above the King's Chamber; and while equipping the chambers above the

King's Chamber with vibration sensors, Danley discovered evidence of fresh tunnels being dug there. Who was doing the digging? Who authorized it? And what are they looking for? Local officials expressed surprise at the news and stated they knew nothing about it. Danley wrote to me in an e-mail: "Who ever was doing it was being careful to 'hide' their work, there was NO dust downstairs at the time like is mentioned at Hoagland's site[1] and the burlap bags of chips were hauled up to the next level UP and heaped against the wall, along with many water bottles and trash. I do not think that the officials knew about it either as they let us go up there with no chaperone and our inspector was very surprised when I told him I thought there was new digging going on.

"My guess would be that the officials were now simply removing the bags for safety and that's how the dust got down to the Grand hall."

In an interview on the Art Bell radio show on July 25, 1997, Danley described the tortuous path one has to take to access the upper chambers above the King's Chamber. In 1836, over a period of several months, English aristocrat Colonel William Richard Howard-Vyse created access to these chambers by blasting upward through the limestone and granite. The hole he created is more like a chimney, with rough sides enabling footholds to climb up. With the new hole, however, it was obvious the tunnelers had hauled the burlap bags of limestone chips up to the chambers above as they dug, instead of removing them completely from the pyramid. This is obviously a more difficult task and surely must have been a conscious effort to keep the digging secret. Boris Said, a documentarian and producer of the television documentary "Mystery of the Sphinx" with Charlton Heston, was being interviewed along with Danley, and he speculated that the purpose for the digging was the Egyptians' clandestine attempt to reach behind the "door" at the end of the southern shaft in the Queen's Chamber, discovered by robotics engineer Rudolph Gantenbrink in 1993. For now the issue rests, for officials are not admitting any knowledge of the new tunneling and probably will not until such time as they make a remarkable discovery.

As much as the Great Pyramid has deteriorated over the passing millennia, one would think that another hole bored into the heart of this structure would not matter much. But it seems to be creating quite an emotional stir among those who revere this edifice and who view it as an inheritance for the world

rather than the personal property of the Egyptians. Even with this deterioration, though, the quality of the workmanship that went into building the pyramid is still evident, and its tremendous significance has prompted many alternative theories as to its function. What scholars and laypeople must remember is that *any* theory that purports to explain the purpose of the Great Pyramid should be mindful of each aspect of its physical existence. The material evidence found within the Great Pyramid did not just spring into existence, but was the result of a physical event, whether the event was planned or not. Thus, every single discovery, observation, and peculiarity—carelessly noted or closely scrutinized by researchers—was the result of some planned action by the pyramid builders or was the effect of a definite cause. Everything about the Great Pyramid has an answer.

The Great Pyramid is the largest, most precisely built, and most accurately aligned building ever constructed in the world. To my mind it represents the "state of the art" of the civilization that built it. (State of the art describes a condition of excellence, wherein the pursuit of any occupation and the product of that occupation is the best example of it, using the most up-to-date methods available for its completion.) There is no evidence to support the speculation that a civilization, for one brief period of time, could produce work that is so advanced it would be considered supernatural to the members of that society. We will get further in our understanding of the Great Pyramid if we follow the premise that it is an accurate reflection of the technology that was developed and used by the society that built it.

Many technologists concur that the state of the art evident in the Great Pyramid is, by modern standards, very advanced. As the technological achievements of a society advance with time, the state of the art in any particular field continually improves as new methods are implemented. The technology we enjoy today has progressed gradually over the years, and each improvement has redefined the state of the art, and with it, our lives. These improvements are not designated to just one area, and many times an improvement or a discovery in a particular science has enabled other professions to advance. As a result, a balance is maintained between the sciences; and in climbing the ladder of technological progress, one area of science may install a rung with which another may climb higher.

We are not unduly amazed when confronted with a display of our own

society's technological advancements, for in viewing the end product, we are aware to some degree of the technology employed in its creation. For instance, as we stroll through our climate-controlled shopping malls, we take for granted the use of advanced machines and the high-tech methods of manufacturing and construction that make them possible. But if we were completely unaware of the techniques and machinery used to build such a complex, we would undoubtedly be stupefied as to how it came into being.

This bewilderment has affected many students of ancient cultures, particularly of Egypt, because we have been taught that the only means of construction available to the builders of the Great Pyramid were manpower, ropes, and tools of copper, stone, and wood. As researchers attempt to reconstruct—in their minds, on paper, and sometimes even physically—the achievements of these ancient, technologically "primitive" builders, they are amazed at the lack of correlation between what they see rising from the desert floor and what they "know" to be history.

Many theorists, unable to reconcile the rift between accepted theory and the fact of these magnificent structures resort to supernatural theories to explain who built the Great Pyramid and how. They surmise that:

- the Great Pyramid was built by super beings who came to Earth from another planet.
- the Great Pyramid was built through divine inspiration.
- the Great Pyramid was placed on Earth, completely intact, by the hand of God.

Still other researchers and authors of books about the Great Pyramid speculate that it embodies an ancient and lost science. They subscribe to the belief that the practitioners of this science built the pyramid as testimony to the knowledge they had developed and because they believed in the prophecy of a future cataclysmic event. David Davidson, a structural engineer from Leeds, England, theorized that the Great Pyramid is similar to a time capsule left by some fantastic civilization for the benefit of a future generation that possesses the ability to unlock its secrets and reap the benefit of the knowledge stored there.

In my view, however, the Great Pyramid reveals too much practical experience and technological knowledge on the part of its builders to suggest that they suddenly diverged onto a path of symbolism and occultism. If indeed we benefit through our study of the Great Pyramid, perhaps realizing that the ancient Egyptians were very advanced, then these more speculative theories might have some basic truth to them. As an engineer, however, I am mindful that *our* civilization's major construction projects are not financed on the collateral of some future generation thousands of years hence, but are built to serve the needs of today's society. It is likely that some of our larger construction projects would survive a world catastrophe and last for several thousand years. For example, if a disturbance around the globe returned us all to the Stone Age, the Hoover Dam, a colossal construction project of modern times, would be viewed with awe if the science and technology that were needed to build it had been lost to everyone. This dam, and others like it around the world, was not built to serve some far distant civilization, but to fill a need at the present time. Financing was provided on the basis that there would be some return on the money invested in it. It seems logical to assume, therefore, that the builders of the Great Pyramid, especially the financiers of its construction, were expecting some return on the resources they invested.

The construction date of the Great Pyramid has been speculated to be from 4,800 years to 73,000 years ago. An Arab writer, Abu Zeyd el Balkhy, estimated the oldest date from an ancient scripture. He claimed that it was built at the time when the Lyre was in the constellation of Cancer, which has been interpreted as meaning "twice 36,000 years before the *Hegira,"* or around 73,000 years ago.[2] (The *Hegira,* or *hijrah,* was the flight of the prophet Mohammed from Mecca to Medina to escape persecution and is dated A.D. 622. The term hijrah also relates to the migrations of the faithful to Ethiopia, as well as those of Mohammed's followers to Medina before the fall of Mecca.[3])

The earliest date of 4,800 years was suggested after the discovery of a cartouche, or royal inscription, inside a scroll-shaped design painted on the ceiling of the top so-called construction chamber above the King's Chamber. This cartouche was supposedly the emblem of Khufu, called Cheops by the Greeks, who is said to have reigned in Egypt 4,800 years ago. Some writers have thrown doubt on the authenticity of this and other cartouches and claim

that Howard-Vyse forged them while working during his 1836-37 expedition. It is suspected, from his diary—which he updated daily—that he was overly anxious to provide significant discoveries to his familial benefactors, who had provided him with Â£10,000 sterling for his expedition. It is reported that members of royalty were visiting Egypt at that time, and he wanted them to view something more than just the unadorned stone. On the day he opened the chamber where the cartouches were found, Howard-Vyse made no mention of them in his diary. The following day he directed others into the pyramid to witness them. It was as if they appeared overnight.[4] Other writers insist that they are authentic. John Anthony West, during a recent telephone conversation, told me that he had recently climbed to the upper chambers and is quite convinced that the cartouches were painted on the stones at the time of the building.

The pyramids are products of a society that is known to have put a great deal of emphasis on death, the afterlife, and associated funerary trappings. Consequently, it is not surprising that these huge, mysterious edifices would be labeled as tombs. What else could they be? However, the Great Pyramid and its neighbors still remain a mystery to many people who have studied them. I am one among many who do not believe the tomb theory, although I recognize that there are those who see no mystery and who have satisfied themselves that this is the "true" function of the pyramids of Egypt. In all fairness, it should be stated that the theory proposed by Egyptologists has been around for quite some time and has become an unquestioned belief for many academics and laypeople alike. It is worthwhile to note, however, that Egyptologists do not claim to know everything about the builders of the pyramids. They confess, at times, to be unsure of many aspects of the construction methods used to build them. Nevertheless, they seem unified in their belief that the pyramids were the tombs of the ancient Egyptians.

But if this is so, where are the mummies that were supposedly buried in these pyramids? According to one Egyptologist, there are not any! In 1975, during a leisurely stroll around the Giza Plateau, u.s. Egyptologist Dr. Mark Lehner told William Fix that no original burial has ever been found in any pyramid in Egypt![5] Is this a revelation to you? It certainly was to me. Still, many people identify the pyramids with the discovery of King Tutankhamen's tomb. I remember seeing an old newsreel that flipped from

the Great Pyramid to the Valley of the Kings dramatically—and incorrectly—proclaiming that the valley was in the shadow of the pyramids.

A greater awareness of those who oppose these kinds of reports has tempered this example of loose reporting, and the media has increasingly raised legitimate and difficult-to-answer questions that challenge the orthodox framework of Egyptology. After all, Egyptology is not a unique branch of science that is isolated from all others. Explaining the construction and manufacturing methods of the ancient Egyptians might well require an expertise in science and engineering that many Egyptologists do not have. But even when increasingly faced with opposing views, Egyptologists gloss over the construction methods and purpose of the pyramids and many other artifacts. This is not surprising, considering that simplistic and primitive explanations do not satisfy the evidence.

In a recent interview, British Egyptologist Dr. I. E. S. Edwards lamented that there were too many pyramids in Egypt and that pyramids had received a bad name in Egyptology circles because "they have attracted too many cranks." I am not sure what he intended by that remark, but there are many people in the world today who are questioning those Egyptologists who stubbornly cling to a speculation that has little objective evidence to support it. Although Edwards does not identify specifically whom he considers to be a crank, it is generally understood by those who have an interest in the Egyptian pyramids that anyone who offers a theory opposing the official line is at risk of being labeled a crank or a "pyramidiot." To Egyptologists, a pyramidiot could be the likes of proponents of Pyramidology, the divine inspiration school whose members have included John Greaves, John Taylor, Scotland's Astronomer Royal C. Piazzi Smyth, Joseph Seiss, J. Ralston Skinner, David Davidson, and James and Adam Rutherford. They see the Great Pyramid as a bible in stone and have prepared a chronology of biblical history based on the measurements of the inner chambers and passageways of the Great Pyramid.

Those who have been skeptical of Pyramidology—but avid students of some form of alternate view—include Sir J. Norman Lockyer and the "pyramid power" people including Antoine Bovis, Karl Drbal, and G. Patrick Flanagan. Then there are the popular-selling treatments of the mystery of the pyramids from Robert Bauval, Graham Hancock, Colin Wilson, Erich von

Daniken, William Fix, Kurt Mendelssohn, and Max Toth. The works of Peter Tompkins, while hinting at an esoteric, alternate viewpoint, stand apart from the other popular works in this genre by virtue of their scope, clarity of research, and presentation.

Viewpoints that differ from the official interpretation of the Great Pyramid are not uncommon. Unfortunately, new viewpoints have not always inspired respect. Nevertheless, even though opposing views regarding this ancient artifact have not had a lasting effect on the most widely believed tomb theory, there are researchers who have worked tirelessly to bring their revisionist ideas forward. In the process, they have revealed a significant amount of detail on the subject to the general public. Without their efforts, much of this information would have been forgotten or lost in some relatively arcane academic journal.

Some authors who have attempted to debunk the Egyptologists' line of thought have, it appears, unwittingly fed fuel to their academic fire by presenting highly subjective evaluations of the structures. These evaluations are sometimes based on poorly researched and one-sided data. For example, one theory has it that the pyramids were built by extraterrestrial beings as landing pads for their spacecraft.[6] If that was the case, where did the aliens initially land their craft so they could build these structures?

While Egyptologists may be stumped regarding certain aspects of the pyramids, they are justified in defending their beliefs against such speculations. Nonetheless, even though these speculations may be blind stabs in the dark, they do reflect an increasing disenchantment with the traditional interpretation of these structures. Many who oppose the tomb theory are engineers, who understand the physical requirements needed to produce largescale engineering works, and technologists, who understand what is behind the creation of precision work.

Unfortunately, the revisionist opinions are too fragmented to have inspired any serious consideration by academia, and the Egyptologists could well use this situation as an argument for their case. One can hear them asking, "How do you expect us to consider an alternative theory for the pyramids when you cannot agree among yourselves?" Until an answer is found for the true purpose of the pyramids, and until that answer is universally accepted, the concerted voice of the Egyptologists will continue to dominate our

encyclopedias and textbooks, and, subsequently, the education of our children. Until such a day, orthodoxy holds sway. After all, finding a large building containing an empty box that resembles a burial sarcophagus, does, on the surface, certainly promote the speculation that it was a tomb.

So what is all the fuss about? Why can't Graham Hancock, Robert Bauval, John Anthony West, and others who have championed new theories, accept what is "common" knowledge?[7] Why risk one's personal reputation and livelihood if there is a shred of evidence that supports the orthodox view of prehistory? I suppose it is a simple matter of having a burning desire to know and understand the truth. I have looked at the evidence, and there is no doubt in my mind that in order to understand the truth regarding the Great Pyramid, we must first discard the tomb theory and look elsewhere for answers. But first, let us look at the orthodox theory a bit more closely (see Figure 1).

There was a time when thinking the Great Pyramid was anything but a tomb may have been considered close to heresy. Nevertheless, this idea is not a modern fantasy of New Age seekers of truth. Other Egyptologists and researchers as far back as 1880 also have made known their doubts. Regarding the tomb theory, Piazzi Smyth wrote, "And this notion finds much favour with the Egyptologists, as a school; though facts are numerously against them, even to their own knowledge." Quoting Sir Gardner Wilkinson, an Egyptologist of that decade, Smyth continued, "Sir Gardner's gentle words, we repeat, are: "The authority of Arab writers' (alluding to those who had described something like the dead body of a knight with a long sword and coat of mail being found in the coffer) 'is not always to be relied on; and it may be doubted whether the body of the king was really deposited in the sarcophagus (coffer) of the Great Pyramid'" [parenthetical comment within Wilkinson's quotation is Smyth's].[8]

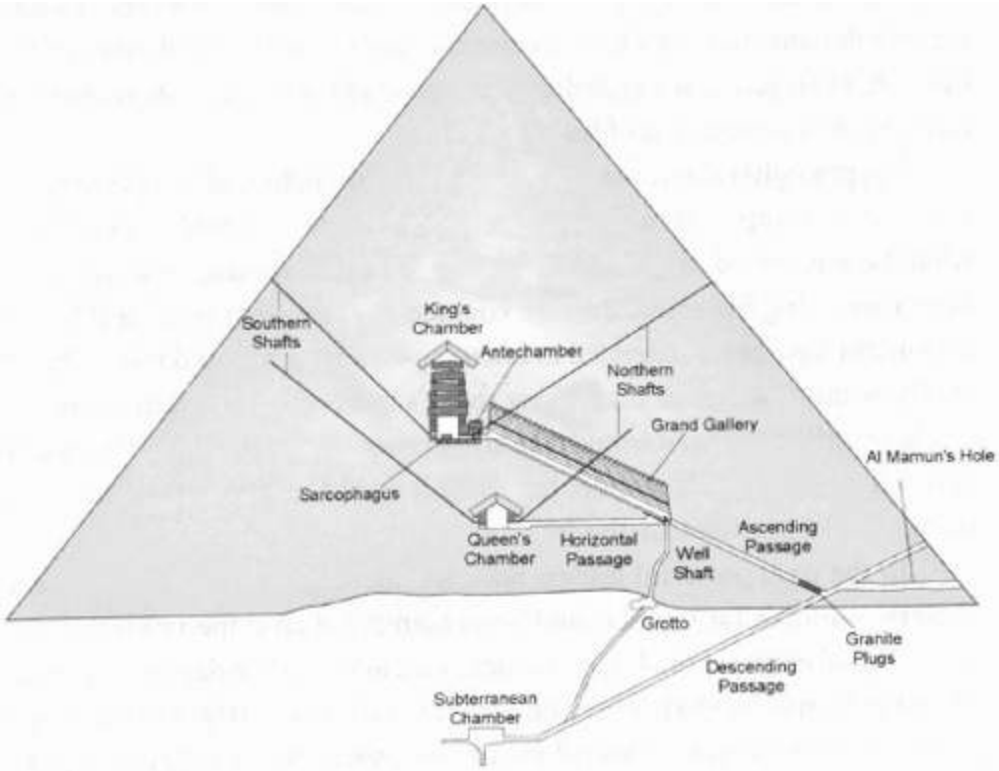


FIGURE 1. ***The Great Pyramid***

Despite the doubts cast by Smyth and others, Egyptologists have over the years amassed as many as 20,000 publications to support their theories and they remain secure in their speculations and in the chronology they have established for the Egyptian dynasties. The lifestyles of the ancient Egyptians and of the kings, queens, and pharaohs who reigned over this society are well documented, and they are not my concern in this book. What I am interested in is just how Egyptologists propose a king or pharaoh might have directed the construction of his pyramid.

Egyptologists claim that Khufu began construction of his pyramid so it would be completed in time to accept his corpse. I should imagine that while he was considering what style of pyramid he wanted, he would have been consulting his architects and engineers to see what was feasible. He also might have been interested in knowing how long it would take to build and how much it would cost. Using today's technology, modern stonecutters have estimated that it would take at least twenty-seven years just to quarry and deliver the stone.[9] I wonder how long it would have taken Khufu's men using simple, primitive methods?

In the past, powerful leaders have erected large-scale works to satisfy their egos. India's Taj Mahal would be an example of an emperor's influence. The Mughal emperor Shah Jahan ordered it built after the death of his wife, Mumtaz Mahal, in 1631. With the concerted effort of 20,000 workers, the mausoleum building was erected in just two years, although the entire complex took twenty-two years to finish, at a cost of forty million rupees. Thus, it cannot be argued that an ancient leader could not amass the resources needed to fulfill any egotistical desires he might have about the afterlife, even if these desires and their fulfillment seem to be illogical to modern pragmatists.

There are, however, explicit engineering qualities associated with the pyramids that do not support the theory that it was a temple, a tomb, or a mausoleum. The redundancy of masonry in these structures is only one good argument against the tomb theory. More persuasive is the fact that Egyptologists woefully lack the material evidence to support it—there are no bodies! It is a widely held popular belief that Egyptian pyramids contained mummies, and that these mummies were actually discovered inside the pyramids. This is simply not true. These beliefs are only inferences that are reinforced by inaccurate documentaries that link the pyramids closely with the Valley of the Kings, where there are no pyramids, but where the mummies actually were found. In reality, the Giza Plateau and the Valley of the Kings are two vastly different sites, separated by hundreds of miles of desert. It is now becoming widely recognized by people who research the pyramid issue that of all the pyramids excavated in Egypt, *there was not one* that contained an original burial. Considering that more than eighty pyramids have been discovered in Egypt, this fact alone practically negates the tomb theory.

William Fix closely studied the subject of original burials, and he came up with some startling information regarding the absence of mummies in the pyramids: "The standard explanation for this is that every single pyramid was emptied by grave robbers in search of treasure. Grave robbery is undoubtedly one of the archaeological facts of life, and so is the later expropriation of some of the pyramids for burial purposes—a practice which at first misled archaeologists and seemed to support the tomb theory. During the Saite period (663-525 B.C.) there was an intense revival of interest in the pyramids

and it became a 'fad' to use them as tombs. It is generally agreed that the coffin lid fragment found in the Third Gizeh Pyramid was stylistically a product of the Saite period, although the bones appear to be even more recent."[10]

Fix related that in 1837, sixty mummies were discovered in a large gallery under the Step Pyramid at Saqqara, fifteen miles south of Giza (see Figure 2). It was discovered later that the mummies were interred approximately 2,400 years after the pyramid was built and not long after the gallery had been excavated beneath the existing prehistoric pyramid. Both events took place during the Saite era.

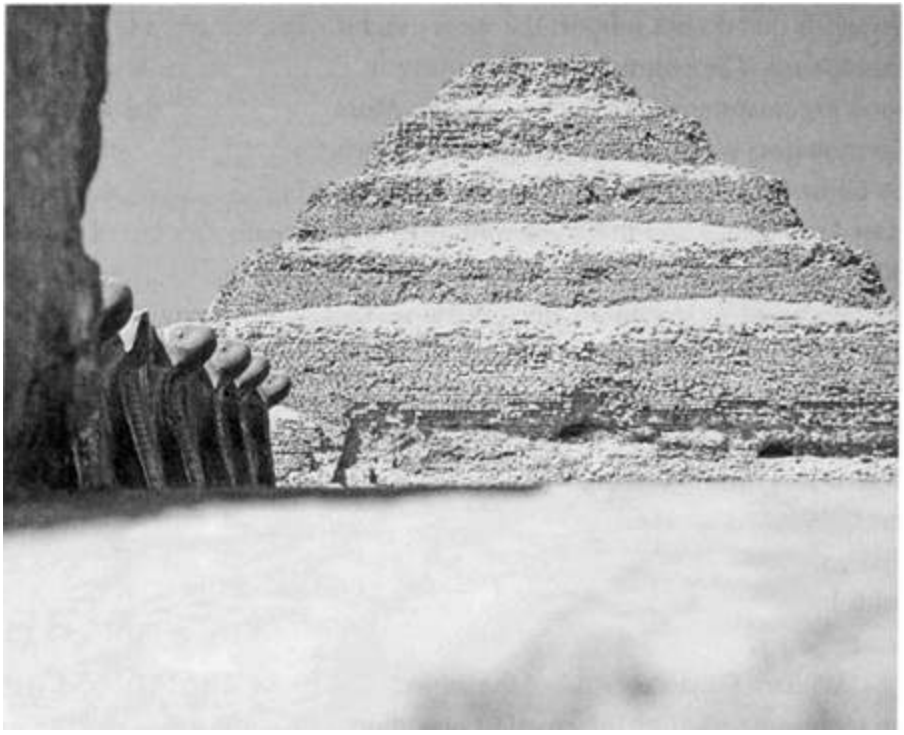


FIGURE 2. ***Step Pyramid***

While we cannot assume that all individuals or groups of individuals always operate on the same principles of logic as ourselves, there has to be some firm base on which to postulate the probable actions of individuals in a given situation. It seems, therefore, sensible for Fix to write, "If only a few intact burials had been discovered, it would be easier to accept grave robbery as the fate of the others. But without so much as a single original burial, the tomb theory seems to have a large hole in it. Why would thieves seeking gold

and jewels also take the corpses?"[11]

Another remarkable but little known fact concerning the alleged pyramid tombs is that while the emptiness of most of them could be blamed on grave robbers, there were some undefiled "tombs" with sealed sarcophagi that were completely empty when they were first opened. Physicist Dr. Kurt Mendelssohn wrote, "The fact that the sarcophagi in the Khufu and Khafre pyramids were found empty is easily explained as the work of intruders, but the empty sarcophagi of Sekhemket, Queen Hetepheres, and a third one in a shaft under the Step Pyramid, pose a more difficult problem. They were all left undisturbed since early antiquity. As these were burials without a corpse, we are almost driven to the conclusion that something other than a human body may have been ritually entombed."[12]

Without the presence of at least one mummy, what proof is offered to support the tomb theory? Inscriptions in the masonry of some of the pyramids have been interpreted as belonging to various dignitaries and generally are offered as the most conclusive proof of ownership of the pyramids. The presence of granite boxes that look like caskets in some of the pyramids is presented as more proof. This "proof", however, identifies only geometry and craftsmanship, not support for a theory that is highly subjective and based entirely on speculation.

The geometry and craftsmanship in the Great Pyramid have been topics of great interest and speculation for centuries. Lacking any evidence that a body was ever entombed there, but still clinging to their views, orthodox Egyptologists have been obliged to provide an explanation for the peculiar features of its passages and chambers. How do they explain the Descending Passage, Subterranean Pit, Ascending Passage, Horizontal Passage, Queen's Chamber, Grand Gallery, Antechamber, and the five superimposed chambers that overlay the King's Chamber? What explanation is given for the shafts that run from the King's and Queen's chambers to the outside? According to many Egyptologists, the entire interior complex of the Great Pyramid was the result of Khufu's, or the ancient artchitect's, indecision and symbolic reasoning. It appears that the ancient Egyptians changed their minds a lot, which resulted in some very expensive rework. I.E.S. Edwards described King Khufu as capricious in his monumental undertaking: "Externally, the

Great Pyramid appears to have been completed without undergoing any significant changes in its original plan. But internally, great changes were made as construction proceeded."[13] Edwards relates that the builders dug the Descending Passage down to the Subterranean Pit with the intention of having it serve as a burial chamber. A second chamber probably would have been added to the end of the passage that runs south from this chamber, but, according to Edwards, the builders abandoned the entire underground burial plan.

Having changed their minds about a subterranean burial, Edwards says, the builders cut an opening in the ceiling of the Descending Passage and constructed the upward-sloping Ascending Passage, the Horizontal Passage, and then the erroneously named Queen's Chamber. However, the builders changed their minds again. According to Edwards, the plan was abandoned and work began on the Grand Gallery with its corbeled walls and 28-foothigh ceiling reaching deep into the heart of the pyramid to where the granite King's Chamber is now situated. Obviously, Khufu's men were very obliging, even though they had to haul the granite from a quarry five hundred miles away.

To many Egyptologists, therefore, the Grand Gallery is a glorious passageway to the king's final resting place, and the two chambers inside the Great Pyramid are the result of indecision on the part of the builders or the reigning monarch who directed its construction. All the other features of the Great Pyramid are explained away as being either symbolic or cultic—or they are not explained at all. For example, according to Edwards, the northern so called "air shaft," which pierces the mass of the Great Pyramid with gun barrel precision, actually served no practical purpose and was retained only as a symbolic gesture to the traditional downward-sloping corridors of other tombs. He wrote, "These narrow shafts have often been referred to as air channels, but that was not their purpose. The northern shaft was evidently a replica in miniature of the traditional downward-sloping entrance corridor. And so we see yet another example of an architectural element being reproduced out of its original context. It would certainly not have been retained unless a special significance had been attributed to it." Citing a reference in the Pyramid Texts to the constellation of Orion, in explanation of the southern air shaft, Edwards claimed, "Once every 24 hours, three stars in

the constellation passed directly over the axis of the shaft. With its aid, the King could make his ascent to their celestial region and return at will to his tomb."[14]

The explanation for the five overlaying chambers above the King's Chamber was purely a guess at the time of their discovery. It is logical and easy to ask, "What is this for?" But it is sometimes difficult to answer, "I don't know." So when Howard-Vyse discovered the five chambers above the King's Chamber, he speculated that they were included in the design to provide a buffer between the flat ceiling in the King's Chamber and the thousands of tons of masonry above. This guess was accepted on blind faith by others and has been repeated so often it has become ingrained. This explanation for the overlying chambers has not been questioned by Egyptologists—or any other researcher, for that matter. It may be argued that because the King's Chamber was at one time subject to a powerful force—the chamber walls show evidence of having undergone a violent repositioning—and the ceiling did not collapse, Howard-Vyse guessed correctly. However, as I will point out in more detail later in the book, this is a fallacious argument—the disturbance of the King's Chamber is attributed to an earthquake, but no other chambers suffered that fate.

The traditional tomb theory has been constantly drummed into us by documentaries, books, and movies. But despite its predominance, it continues to be questioned. On a more positive note, recently uncovered evidence has prompted some Egyptologists to revise aspects of the theory.

In 1993, Rudolph Gantenbrink, a German robotics engineer, explored the northern shaft leading from the Queen's Chamber using a specially designed robot equipped with a camera and laser pointer. Approaching a sharp bend in the shaft, Gantenbrink's robot, named Upuaut II (Upuaut means "opener of the ways") encountered an obstacle in its path. There was a length of steel pipe jammed in the passage. The pipe presumably was inserted into the shaft by early explorers with the hope of retrieving some artifacts. Not wanting to risk losing the $250,000 robot, Gantenbrink rescued it from this shaft and turned his attention to the Queen's Chamber southern shaft. During this tense mechanical expedition, Gantenbrink made a sensational discovery: At a level that is higher than the King's Chamber, his robot encountered a dead end, with what has been described as a "door" through which protruded two

copper fittings. The implications of this discovery were immediately apparent, and created quite a dilemma for Egyptologists. According to their theories, Khufu changed his mind about being buried in the middle chamber in favor of a chamber higher up inside the pyramid. So if the so-called Queen's Chamber was abandoned for the higher chamber, it would not make sense for the builders to continue to create these shafts as the construction of the pyramid continued.

In order to construct these shafts, the builders had to use a tremendous amount of care. The blocks needed to be cut on an exact angle and fitted together with precision. More care would have been necessary when constructing the northern shaft because the shaft does not go straight through the pyramid. With the same angle in reference to a horizontal plane, the shaft veers to the left to bypass the Grand Gallery and then veers back again once the gallery is cleared. The blocks that were manufactured to accommodate this angle had to have been cut on a compound angle. What we have, then, are a large number of limestone blocks that are precision cut with a bottom surface that is cut on an angle (see Figure 3). Parallel to this surface a rectangular channel is cut to form the walls and ceiling of the shaft. The existence of these shafts, and the precision with which they were manufactured, cannot be explained within the framework set forth by many Egyptologists; thereby they undeniably weaken the tomb theory. I will discuss a more logical purpose for these shafts later in the book.

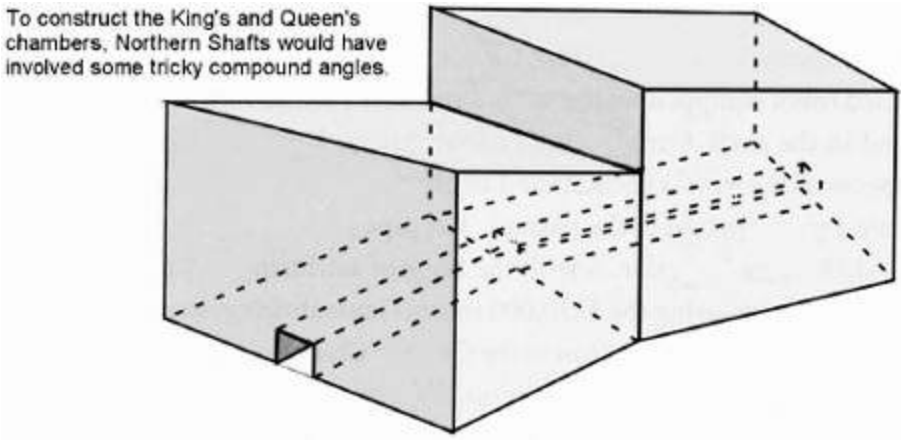


FIGURE 3. ***Example of Blocks Used to Create Pyramid Shaft***

Rudolph Gantenbrink's important discovery has forced many Egyptologists to finally accept that their theories are flawed. This is an interesting

development. Academic mores normally dictate that when a theory contains flaws, or unsubstantiated data that supports critical elements on which the theory is built, the entire theory must either be thrown out or revised. Instead of the tomb theory being dismissed, however, Gantenbrink himself was dismissed from the project. He discovered the "door" on March 22, 1993. A week later, he was told to pack up his robot and leave Egypt. Gantenbrink has the technology to go beyond the so-called door but, presumably because of political reasons, has been refused permission to resume his research in Egypt.

Gantenbrink, with an engineer's typical pragmatism, stated, "I take an absolute neutral position. It is a scientific process, and there is no need whatsoever to answer questions with speculation when these questions could be answered much more easily by continuing the research. Yet because of a stupid feud between what I call believers and non-believers, I am condemned as someone who is speculating. But I am not. I am just stating the facts. We have a device [ultrasonic] that would discover if there is a cavity behind the slab. It is nonsensical to make theories when we have the tools to discover the facts."[15]

Along with the recent discovery of the termination of the Queen's Chamber shaft, there is additional evidence that has been available for over a hundred years, but is seldom mentioned by Egyptologists. Cut into the bedrock about one hundred yards to the east of the Great Pyramid are features known as Trial Passages (see Figure 4). It is theorized that they were excavated to enable the workers to practice and perfect their skills before the Great Pyramid was built.

The Trial Passages are unique in that they are cut purely into the bedrock, yet they do have features that correspond with elements that are constructed, not excavated, within the Great Pyramid. A shortened version of the Descending Passage can be found as well as an Ascending Passage that is cut on the same angle as the one in the pyramid. At the juncture where the trial Descending and Ascending Passages meet there is a vertical shaft that must have fulfilled some need that the builders did not find necessary to include in the Great Pyramid. Where the trial Ascending Passage and the bottom of the trial Grand Gallery meet is an indentation that merely hints at the start of a Horizontal Passage such as that leading to the Queen's Chamber in the actual

pyramid. The trial Grand Gallery displays features found in the Great Pyramid Grand Gallery, notably the steeply rising angle and the side ramps. The dimensions and angles of all these puzzling excavations are almost exactly the same as those in the Great Pyramid.

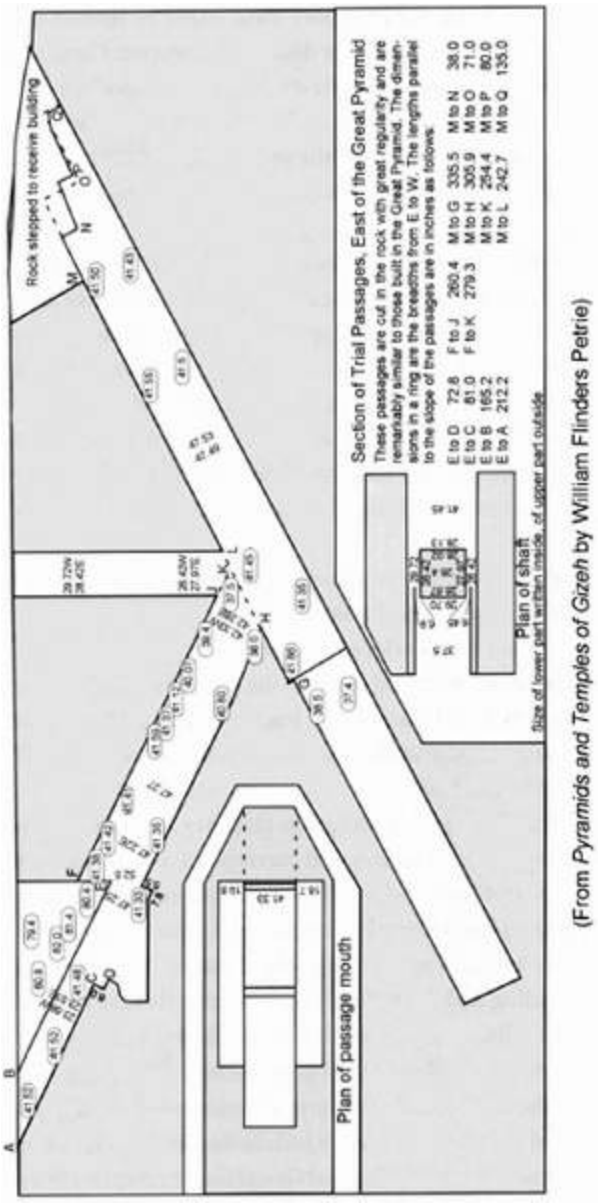

Rock stepped to receive building
Section of Trial Passages, East of the Great Pyramid
These passages are cut in the rock with great regularity and are remarkably similar to those built in the Great Pyramid. The dimensions in a ring are the breadths from E. to W. The lengths parallel to the slope of the passages are in inches as follows.
E to D 72.8 F to J 260.4 M to G 335.5 M to N 38.0
E to C 81.0 F to K 279.3 M to H 305.9 M to O 71.0
E to B 165.2 M to K 254.4 M to P 80.0
E to A 212.2 M to L 242.7 M to Q 135.0
Plan of shaft
Plan of passage mouth
(From Pyramids and Temples of Gizeh by William Flinders Petrie)

FIGURE 4. ***Trial Passages***

William Flinders Petrie went further in describing these Trial Passages with tables of dimensions comparing the Trial Passages with various parts of the Great Pyramid. Table 1 is a reconstruction based on Petrie's table, using his dimensions.[16]

TABLE 1

	Trial Passages		Great Pyramid	
Passage angle	26°32'	mean difference 24'	26°27'	mean difference .4'
Passage widths	41.46	mean difference .09	41.53	mean difference .07
Passage heights	47.37	mean difference .13	47.24	mean difference .05
Ramp heights	23.6	mean difference .08	23.86	mean difference .32
Gallery widths	81.2	mean difference .6	82.42	mean difference .44
Well widths	28.63	mean difference .54	28.2	mean difference .3

The hypothesis that these passages were "trial runs" is questionable, especially when the following observations are considered:

- The passages in question were cut into the bedrock of the plateau. This would require a different technique than those used to duplicate these features inside the Great Pyramid. The excavating skills developed in digging these tunnels would, in all probability, be redundant when the builders turned to constructing the Great Pyramid.
- These "trial passages" are the only ones found on the Giza Plateau. If there had been others of lesser quality, it could be argued that the builders needed the practice, but it is evident by the close similarity between these passages and the ones in the Great Pyramid that the builders knew exactly what they were doing. They already possessed the necessary skills needed to incorporate these features inside the Great Pyramid, making such an exercise, if that is what it was, unnecessary.

It should be noted that Trial Passages were not cut for the Horizontal Passage, Queen's Chamber, Well Shaft, and Subterranean Pit-an interesting point to consider when faced with the traditional tomb theory of why the inner chambers and passages came to be. It is doubtful that both the Trial Passages and the interior chambers of the Great Pyramid were the result of indecisiveness on the part of the builders. The Subterranean Pit, which was supposedly the first chamber that was abandoned by the king, is not even included in these passages. The Queen's Chamber, purportedly the second burial chamber abandoned by the king, also is not included. The King's Chamber, the last and final burial place for the king, is nowhere to be seen in

these Trial Passages.[17]

In the course of events proposed by many Egyptologists, the Queen's Chamber was built after the lower chamber was abandoned. If the builders decided to excavate the Trial Passages after they had also rejected the Queen's Chamber, we may ask why include the Descending Passage and the Ascending Passage, which must, after all, have been already built into the pyramid? The most striking detail in this investigation is that the builders went to a lot of work to excavate these Trial Passages, and, at that stage, they were placing more emphasis on the passages than on the chambers.

It is reasonable to conclude, and the Trial Passages prove, therefore, that the builders planned the Ascending Passage and the Grand Gallery before beginning construction. More than likely they also planned the King's Chamber. We can conclude, therefore, that the interior design of the Great Pyramid was conceived before the construction started, with nothing added later, be it on a whim or for any other motivation.

With a weight of evidence opposing the traditional sequence of events in the Great Pyramid, Egyptologist Mark Lehner has modified the theory to accommodate its lack of logic. In his book *The Complete Pyramids*, he wrote, "Inside Khufu's pyramid we find developments that are unique in pyramid evolution and remarkable in the entire history of architecture. Many Egyptologists have long accepted Borchardt's suggestion that the pyramid's three chambers represent two changes in plan, with the abandonment of the Subterranean Chamber, believed to be the original intended burial chamber of the king, and then the Queen's Chamber, in favour of the King's Chamber. Several clues, however, combine to make it probable that all three chambers and the entire passage system were planned together from the outset. Three chambers seem to have been the rule for Old Kingdom pyramids."[18]

Although it is probably no more than an afterthought, given to rationalize the existence of three chambers inside the Great Pyramid, Lehner's last sentence, as amply illustrated and described in his book, is not quite accurate. Djoser's Step Pyramid at Saqqara is riddled with three and one-half miles of tunnels that branch off and then converge into a central shaft at the bottom of which is a single burial chamber. The pyramid at Meidum has only one chamber. The Bent Pyramid at Dahshur has arguably two chambers and one

so-called antechamber. Khafre's pyramid, which is next to Khufu's, has only two chambers. The Pyramid of Sahure at Abusir has only one chamber. Several other pyramids listed in Lehner's book also contain fewer than three chambers.[19]

By virtue of their design, the interior passageways and chambers within the Great Pyramid are difficult to explain according to the tomb theory. Orthodox explanations are strained and unconvincing, more so because Egyptologists offer differing opinions regarding the sequence of events during the Great Pyramid's construction and the intended purpose for its principal chambers. There are differences of opinion, too, between Egyptologists and professional architects regarding the establishment of its architectural attributes. In order for the tomb theory to be valid, an impossible feat must have been performed by the guardians of the Great Pyramid after the funeral procession had departed. Jammed within the lower part of the Ascending Passage are three huge blocks of granite that block the passageway that leads to the supposed burial chamber. Egyptologists propose that the blocks were originally stored in the Grand Gallery, held in position by wooden pegs inserted into slots, and then released to slide down the Ascending Passage and into position after the funeral procession had exited the pyramid. Yet architects and engineers claim that this would have been impossible and that these blocks had to have been installed as the pyramid was being built. In order for these blocks to slide down the passage, there would had to have been a half inch or more of clearance between the blocks and the passageway, whose surfaces would had to have been as smooth as glass to overcome friction.[20] The fact is that these blocks fit into the passage without any clearance on the sides; and the limestone walls, which mayor may not have been smooth, would more than likely have been scoured by the harder granite as it pushed past. In addition, past these granite plugs the Ascending Passage pierces the heart of the pyramid at a 26°8' angle. Even with a clear passage—without the granite barriers—for a burial party this does not make sense, as the passage is only forty-one inches square, with barely enough room for a person to pass.

Nonetheless, in order to uphold their theory that the pyramid was indeed used as a tomb, Egyptologists must propose that the Ascending Passage was clear of obstruction. The only other way into the pyramid would have been through a small, cramped, almost vertical shaft that connects the lower

Descending Passage with the Grand Gallery—certainly not a very dignified final journey for a king. So how do we reconcile the differences in opinion between Egyptologists and technologists regarding the physical realities of the theory? Obviously we are not going to re-enact the event in order to prove or disprove the theory one way or another, so the only way to settle the issue is to come up with an alternate theory that, in light of the physical evidence, makes more sense.

In this endeavor we are faced with a catch-22. The evidence cannot be explained within the parameters set by the tomb theory, so any theory that proposes that the pyramid was not a tomb is going to be immediately suspect and in all likelihood rejected out of hand. This is both good and bad. All theories should be suspect, but they should at least be objectively reviewed before being rejected. Such objectivity, in light of all the preceding arguments, can lead us to only one likely conclusion: There is precious little evidence to support the traditional tomb theory. Indeed, the evidence proves that it is altogether erroneous. Researchers who face the facts have made suggestions that the Great Pyramid must have served some other purpose. I agree. Considering the amount of effort that went into building it, and the precision of its execution, the pyramid's function must have been extremely important to its builders, more important even than serving as the final resting place for the king. So what was the function of the Great Pyramid? It is time to look at the evidence with a fresh eye and an open mind. As you will see as we progress through the book, the evidence that leads us away from the tomb theory will strongly support another theory: that the Great Pyramid was a highly sophisticated machine, with a function that was more fantastic than we have, until now, even dared consider.

Chapter Two

QUESTIONS, DISCOVERY, AND MORE QUESTIONS

*Around A.D. 820, Caliph Al Mamun was inspired by reports of trea*sures within the Great Pyramid, and directed his men to search for an opening to the inside. Not finding such an opening, they resorted to breaking through the hard limestone exterior by lighting fires against the stone, then pouring vinegar on the heated rock. Once they were through the hard case, the softer limestone core-masonry yielded more easily to their chisels and they proceeded to hack out a tunnel. After blindly working for what seemed eternity, Al Mamun's men were about to quit, when they heard a muffled sound coming from within the pyramid. Redirecting their efforts toward the source of that sound, they eventually connected with the Descending Passage. But their efforts did not cease there. Finding only a long Descending Passage with a lonely Subterranean Chamber at the end, Al Mamun turned his attention to evidence of other possible passages. The bottom side of a large granite plug in the ceiling of the Descending Passage indicated to him that if he cut around the granite, he would find other passages. After chiseling around three granite plugs, Al Mamun's men opened to the world the inner chambers of the Great Pyramid. Each year, thousands of tourists follow the path that Al Mamun carved into this structure.

After Al Mamun's fruitless and disappointing search for treasures, there was little attention paid to the edifice, with the exception of using it as a quarry. Bats took over the inner passages and chambers, and suspicion took over the minds of the local inhabitants. Without modern illumination, few would dare to go inside, especially at noon and sunset, when a naked woman with large teeth who seduced people and drove them insane reportedly haunted the pyramid. Rabbi Benjamin ben Jonah of Navarre reported that

"the Pyramids which are seen here are constructed by witchcraft."[1]

After Europeans started to travel to Egypt, information regarding the wonders found there began to find an audience in Western civilization. Fueled by their own curiosity and this intense interest at home, European explorers in the area were quite energetic in studying, searching, and noting just about anything, no matter how seemingly insignificant, pertaining to the Great Pyramid. As one researcher followed another, more knowledge of this pyramid was uncovered and revealed to the world.

John Greaves, a British mathematics teacher and astronomer, visited the Great Pyramid in 1638.[2] He made studies with which he hoped to find information establishing the dimensions of the planet. During his explorations, Greaves discovered what was to be known as the Well Shaft. The Well Shaft is located at the bottom of the Grand Gallery through an opening in the west wall and is approximately three feet wide. The notches cut into the sides enabled Greaves to lower himself into the bat-infested bowels of the pyramid.

Climbing down, Greaves reached a level that was sixty feet below the level of the Grand Gallery. Here he came across a small round chamber cut into the limestone bedrock. Beyond this small cavern, and deeper still, the shaft continued downward. Not knowing what lay beneath him or whether a bottomless pit might swallow him up, Greaves dropped a lighted flare down the hole. He noted that the flare continued to flicker from the depths and assumed that the shaft terminated at that point. Deciding that he had crawled around enough for one day, Greaves made his way out into the fresh air, leaving the stifling shaft to its resident bats.

This discovery left Greaves extremely puzzled, for the Well Shaft did not seem to serve any purpose. The cavern, which is now known as the Grotto, was equally perplexing. It seemed pointless to Greaves to dig a shaft to nowhere and to enlarge a part of the shaft into a grotto. This perplexity affected later explorers as well.

In 1765, Nathaniel Davison, while vacationing in Egypt, was able to carefully explore the Great Pyramid. Going farther than Greaves, Davison was lowered by rope another one hundred feet below the level of the Grotto. Here he encountered a blockage in the shaft. Why anyone would go to the

trouble of digging a shaft, with no apparent purpose or destination, almost two hundred feet into the heart of the pyramid, was a mystery to Davison.

A part of this mystery was to be solved when G. B. Caviglia, the Italian captain of a Maltese ship flying the British ensign, quit his maritime occupation and undertook the task of exploring the Great Pyramid. Caviglia was determined to shed some light on the mystery of the Well, and, after being lowered past the level of the Grotto by some Egyptian helpers, he attempted to clear the blockage that Davison had encountered before him. The blockage appeared to be just loose sand and rock, so Caviglia filled baskets with the debris and had the helpers raise the baskets up and out of the shaft. He could not persuade them to work for long, though, for the air became so foul with clouds of dust and the stench ofbat dung that the men were about to suffocate. Caviglia burned chunks of sulfur in an attempt to purify the air, but this ploy did not impress his helpers, who refused to continue working.

Still determined to find some reason for the shaft, Caviglia decided to clear the Descending Passage down to the Subterranean Pit. Al Mamun's men had used this passage as a dumping ground when they were cutting around the plugs that filled the Ascending Passage. With his helpers back on the job and carrying the chippings out of the pyramid, Caviglia slowly and painfully inched his way downward.

His extreme discomfort was eventually rewarded when he discovered a low doorway on the west side of the passage. Through this doorway, a hole bored upward into the heart of the pyramid. The smell of sulfur was evident inside the doorway, and Caviglia deduced that perhaps this smell was from the sulfur he had previously burned. Digging upward, Caviglia and his workers, with limestone chips and dust showering down on them, finally broke through into the Well Shaft, thereby completing the connection between the lower parts of the Descending Passage and the Grand Gallery.

Caviglia, like Greaves and Davison before him, was still faced with the same questions: Who dug the Well, when was the Well dug, and why? Another aspect of this same mystery, which further increased his perplexity, is that from the junction of the Grand Gallery and the Horizontal Passage down to the level of the bedrock, it appears that the Well Shaft actually had been included in the original plans for the construction of the pyramid. From

the level of the Grand Gallery down to the bedrock, the walls of the Well Shaft are symmetrical in their construction, and, although they do not have the precise, fine finish that is evident in other passages and chambers, their features do not resemble those of a tunnel cut as an afterthought through solid masonry, such as the forced passage dug by Al Mamun's men.

It has been speculated that this shaft was dug by grave robbers who broke into the pyramid to strip it of its treasures. This theory has been refuted by some who have debated whether or not a band of thieves would have the knowledge, perception, or sheer luck to dig a blind passage with such accuracy that it would eventually meet with the Grand Gallery, which is only a few feet wide.

In contradiction to the grave robber theory, David Davidson, a structural engineer from Leeds, in the north of England, developed a scenario of prehistoric events that, in his mind, met the demands of logic and common sense, and at the same time explained the existence of the Well Shaft.

Davidson, after spending several months studying the pyramid, felt that the Great Pyramid was not originally intended for the use of the people who built it or their king; rather, it was designed to be used as a "time capsule" in which knowledge would be preserved for the benefit of a future civilization. In a professional capacity, he also maintained that the plugs inside the Ascending Passage were positioned as the level of the pyramid grew higher. According to Davidson, to have slid them down the passage without them jamming in the process would have been an unlikely feat, as the clearance at the sides of the passage would not have been sufficient to allow them to pass freely.

Davidson's scenario was set shortly after the Great Pyramid was built, or not many generations after—before knowledge of the design of the interior was lost or forgotten. He theorized that following a violent earthquake, or some other equally devastating occurrence, the guardians of the Great Pyramid noticed some subsidence effects of the structure on the outside. Fearing that the King's Chamber also might have suffered from the disturbance, they decided to enter the pyramid to investigate. To do this, they started to dig upward near the bottom of the Descending Passage. Davidson explained that instead of taking a possible shorter route, such as taken by Al Mamun at a later date, the guardians chose their route so that they could inspect two large fissures in the bedrock of the Descending Passage.

Although these fissures can be seen in the Descending Passage, what knowledge did the guardians of the pyramid have that assured them that the unseen portion of the fissures followed a predictable direction? Would they have been able to plot the course of their tunnel with assurance that, as they bored through the limestone bedrock, they would cross the same fissures at two points? Without this assurance, would such a difficult and time-consuming project be undertaken?

Knowing that the Great Pyramid's thirteen-acre base was surveyed using modern instruments and found to be level within 7/8 inch—an astounding accuracy by modern standards—it does not make much sense to suggest that the guardians would be concerned about any subsidence. Moreover, it would be interesting to know what extent of damage the guardians thought these fissures would have on the King's Chamber, which, after all, was their primary concern. The King's Chamber is located 175 feet above the ground level. There were no disturbances noted in the Queen's Chamber or the Horizontal Passage. In 1881, Sir William Flinders Petrie surveyed the Descending Passage, where the fissures were noticed, and discovered that it was remarkably accurate. He found the passage to have an error of only .020 inch over the 150-foot length of the constructed portion; and the entire length of the passage, both constructed and excavated, was within a minuscule quarter inch over 350 feet.[3] This hard data brings into question the widely held theory that an earthquake was the cause of the disturbance in the King's Chamber. It seems obvious that those who knew the interior design of the pyramid dug the shaft. Considering the amount of work involved in digging it, the Well Shaft that connects the Descending Passage with the lower portion of the Grand Gallery must have been a part of the original design of the pyramid and served a specific purpose for its builders.

Nevertheless, Davidson's theory is given the benefit of the doubt by Peter Tompkins, who said, "There is nothing inherently illogical about this version of events. It would have been no easy job to tunnel upwards through the solid rock and various courses of masonry—altogether hundreds of tons of material would have had to be chipped away and taken out of the pyramid up the descending passage—but it would not have been impossible."[4]

It is absurd to propose that this feature of the Great Pyramid exists through

the efforts of tomb robbers who were digging blindly on the chance that they might discover a burial chamber. The physical demands are monumental. Digging upward, the workers would be contending with a small, cramped, almost vertical tunnel in which they would need physical support, light, and oxygen. As they hacked away at the face of their bore, the air would be heavily laden with limestone dust, and fragments would be falling on them and the workers below. The sheer human effort would have been daunting as hundreds of tons of chips were wrestled up the Descending Passage and removed from the pyramid.

Compare the digging of the Well Shaft with Al Mamun's hole. Al Mamun's men, as the story goes, were ready to give it up after digging only one hundred feet. Their patience had reached its limit. It could be asked, therefore, how far this band of treasure seekers would have gone if the task before them had been the Well Shaft. Tompkins went on to say, "What militates against this theory is the observations of Maragioglio and Rinaldi that the walls of the Well Shaft upward from the Grotto are built and lined with regular blocks of limestone, apparently as a feature of the original structure."[5]

In their book, *L'Architettura delle Piramidi Menefite,* Celeste Maragioglio and Vito Rinaldi proposed that the Well Shaft was dug to provide air to workers in the pyramid. Egyptologist and world authority on the pyramids, I.E.S. Edwards, agreed that it may have been used for this purpose, but claimed that within the context of the tomb theory, it would not have been necessary as the Ascending Passage was open until the funeral procession had left and the granite blocks had been lowered into position at the mouth of the passage. Edwards claimed the Well Shaft was an escape route for those who facilitated the lowering of the granite blocks.[6] However, that theory—to me—presents a convoluted nonsensical way of going about things, and is barely worth the time we could spend arguing about it. I find the observations of Petrie more agreeable and likely. He cast doubt on the intentions of the builders, as interpreted by Maragioglio, Rinaldi, and Edwards:

> *The shaft, or "well," leading from the N. end of the gallery down to the subterranean parts, was either not contemplated at first, or else was forgotten in the course of building; the proof of this is that it has been cut*

through the masonry after the courses were completed. On examining the shaft, it is found to be irregularly tortuous through the masonry, and without any arrangement of the blocks to suit it; while in more than one place a corner of a block may be seen left in the irregular curved side of the shaft, all the rest of the block having disappeared in cutting the shaft. This is a conclusive point since it would never have been so built at first. A similar feature is at the mouth of the passage, in the gallery. Here the sides of the mouth are very well cut, quite as good work as the dressing of the gallery walls; but on the S. side there is a vertical joint in the gallery side, only 5.3 inches from the mouth. Now, great care is always taken in the Pyramid to put large stones at a corner, and it is quite inconceivable that a Pyramid builder would put a mere slip 5.3 thick beside the opening to a passage. It evidently shows that the passage mouth was cut out after the building was finished in that part. It is clear then, that the whole of this shaft is an additional feature to the first plan.[7]

Petrie also noted a large block of granite at the level of the Grotto. The block was positioned as though it had been pushed aside from the vertical section of the shaft. What was this block of granite doing down a shaft, which, in many minds, had nothing to do with the original design of the pyramid? After tunneling through virgin rock and reaching the level of the Grand Gallery, why would anybody decide to drop a block of granite down the Well? This would take considerable effort. And where did they get the granite? There has to be a reason for it being there (see Figure 5).

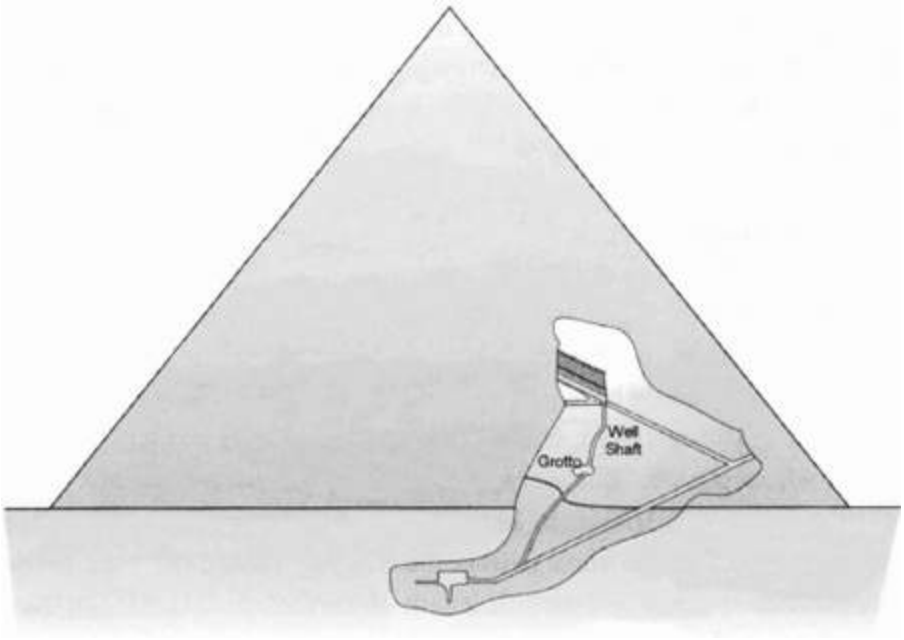


FIGURE 5. ***Well Shaft***

Maragioglio, Rinaldi, Edward, and Petrie's observations can be reconciled by proposing that the constructed portion of the Well Shaft was originally smaller than it is now and was enlarged to allow passage into the Grand Gallery for inspecting the damage in the King's Chamber. If this is true, then perhaps the Well Shaft was designed not for human access, but for something else. Whatever this purpose was, perhaps it called for the inclusion of a large granite block within the passage to serve a specific function. These are questions I will answer later in this book.

If the Well Shaft had been dug by grave robbers, they would have needed to know the internal arrangement of the pyramid, and be sufficiently inspired by what was contained within it to undertake the project. As for the inspection theory, we might ask, "How were the guardians able to discern any subsidence on the outside of the pyramid?" With an error of only 7/8-inch over the entire thirteen-acre base, over a distance of one foot the amount of error would be only .001 inch—less than half the thickness of a human hair! To detect the 7/8-inch error in the base of the Great Pyramid, even if the base were perfectly flat originally, the ancient guardians would had to have been in possession of some remarkably advanced measuring equipment.

Assuming that they had the equipment to measure this minute variation in the pyramid's levelness, would such an insignificant deviation from accuracy

warrant the penetration of the pyramid in the manner theorized? If the guardians were concerned about the fate of the internal passages and chambers, they could have put their minds at rest by closely checking the Descending Passage. As I mentioned earlier, this passage was scrutinized by Petrie who reported, "The average error of straightness in the built part of the passage is only 1/50 inch, an amazingly minute amount in a length of 150 feet. Including the whole passage the error is under 1/4 inch in the sides and 3/10 on the roof in the whole length of 350 feet, partly built, partly cut into the rock."[8]

Nonetheless, evidence indicates that an inspection of the inside chambers of the Great Pyramid was conducted in antiquity and repairs were made. For example, plaster was daubed on the cracks of the ceiling beams above the King's Chamber. But what triggered the guardians' concern for this chamber? If they were to initiate a close inspection of the internal passages and chambers of the Great Pyramid following an earthquake, wouldn't the Descending Passage satisfy their curiosity and put their minds at ease? It would seem that the penetration of the internal chambers of the pyramid was prompted not by the detection of minute subsidence on the outside, but by other observations of the pyramid's form and function.

At the time of Al Mamun's exploration of the Great Pyramid, many untold mysteries remained hidden from his searching eyes. It was not until 1765 that Nathaniel Davison made a discovery that initiated continuing explorations and further compounded the mystery of this enigmatic structure.

Close to the King's Chamber, on the Great Step, a curious echo coming from the ceiling of the Grand Gallery caught Davison's attention. Assisted by the illumination of an elevated candle, Davison scrutinized the gallery ceiling and vaguely discerned an opening near the top. Taking his life into his hands, he erected a precarious collection of ladders and gingerly proceeded to climb to the top.

To his delight, Davison discovered that there was indeed an opening. His pleasure, though, soon turned to disgust as he wedged himself inside the hole and found himself immersed in pungent mounds of bat dung. Using a handkerchief to protect his offended nose, he forced himself into the fetid passage and struggled along in this manner for twenty-five feet until he came across a large chamber not quite high enough to stand in. Once inside this

chamber, Davison cleared away bat dung and uncovered nine enormous granite beams measuring up to twenty-seven feet long and weighing up to seventy tons each. This monolithic ensemble formed the ceiling of the King's Chamber. Unlike the bottom and sides of the beams, though, the tops of them were rough-hewn with no pretension to straightness or accuracy. Davison also noticed that the ceiling of the chamber he had discovered was constructed with a similar row of granite beams. Davison could make little sense of these features, and his only satisfaction in his discovery was to carve his name on the wall and have the chamber named after himself.

Additional exploration of Davison's Chamber came in 1836 when Colonel Howard-Vyse, with the help of civil engineer John Perring, made extensive explorations of the pyramid complex at Giza. In Davison's Chamber, Howard-Vyse noticed a crack between the beams of the ceiling. He perceived the existence of yet another chamber above the one he was occupying. Without obstruction, he was able to push a three-foot-long reed into the crack. Howard-Vyse and his helpers then made an attempt to cut through the granite to find out if there was indeed another chamber above. Finding out in short order that their hammers and hardened steel chisels were no match for the red granite, they resorted to using gunpowder. A local worker, his senses dulled by a supply of alcohol and hashish, set the charges and blasted away the rock until another chamber was revealed.

This chamber held a mystery for the early explorers who entered its confines, a mystery that has baffled people for decades. The chamber was coated with a layer of black dust, which, upon analysis, turned out to be exuviae, or the cast-off shells and skins of insects. There were no living insects found in the Great Pyramid, which made this discovery even more mysterious. What prompted hordes of insects to single out this one sealed chamber and shed their skins? It is a mystery that has never been satisfactorily explained. In fact, there has not been any attempt to explain it, and because there is no logical answer that fits in with any previously proposed theory, no one has given it much attention.

As in Davison's Chamber, a ceiling of monolithic granite beams spanned this new chamber, indicating to Howard-Vyse the possible existence of yet another chamber above. Blasting their way upward for three and a half months, to a height of forty feet, they discovered three more chambers,

making a total of five. The topmost chamber had a gabled ceiling made of giant limestone blocks. Howard-Vyse surmised that the reason for the five superimposed chambers was to relieve the flat ceiling of the King's Chamber of the weight of thousands of tons of masonry above. Although most researchers who have followed have generally accepted this speculation, there are construction considerations that cast doubt on this theory and prove it to be incorrect.

What Howard-Vyse and others have not considered is that there is a more efficient and less complicated technique in chamber construction elsewhere inside the Great Pyramid. The structural design of the Queen's Chamber negates the argument that the chambers overlaying the King's Chamber were designed to allow a flat ceiling. The load of masonry bearing down on the Queen's Chamber, which itself is situated below the King's Chamber, is greater than that above the King's Chamber. Yet the Queen's Chamber has a gabled ceiling, not a flat one. If a flat ceiling had been required for the Queen's Chamber, it would have been quite safe to span this room with one layer of beams similar to those above the King's Chamber. Both the King's Chamber and Queen's Chamber employ huge gabled blocks of limestone that transfer the pressure of the above masonry to the outside of the walls. The fact is that a ceiling similar to the one in the King's Chamber could have been used in the Queen's Chamber, and, as with the beams above the King's Chamber, the beams would be holding up nothing more than their own weight (see Figure 6).

When the builders of the Great Pyramid constructed the King's Chamber, they were obviously aware of a simpler method of creating a flat ceiling. The design of the King's Chamber complex, therefore, must have been prompted by other considerations. What were these considerations? Why are there five superimposed layers of monolithic seventy-ton granite beams? Imagine the sheer will and energy that went into bringing just one of the forty-three granite blocks a distance of five hundred miles and raising it 175 feet in the air! There must have been a far greater purpose for investing so much time and energy—and there is, if we understand the Great Pyramid as a machine. But before I make my case, we must examine more of the evidence and the orthodox theories proposed to explain it.

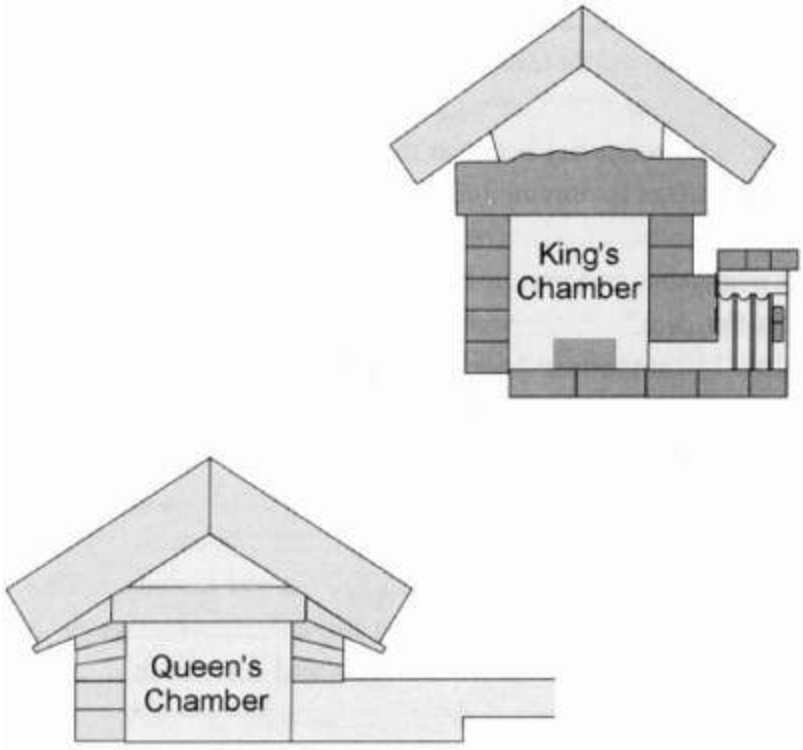


FIGURE 6. ***Queen's Chamber and King's Chamber with Flat Ceiling***

With the discovery of the five superimposed "chambers of construction" above the King's Chamber, the granite complex located at the heart of the Great Pyramid became a mystery and source of consternation. The reason the builders changed from limestone to extremely hard granite could be adequately explained if we consider egos, whims, and religious beliefs to be a driving force in the decision-making process of the ancient builders. However, there are other notable peculiarities concerning the state of some of this granite that do not fit into a logical pattern.

If we focus our attention on the granite-lined Antechamber, we perceive a marked discrepancy between the craftsmanship displayed there and the meticulous care maintained throughout the rest of the Great Pyramid. Other researchers have noticed this anomaly as well. Petrie was astounded at the gross negligence and inferior workmanship he saw in this chamber, and wrote, "In the details of the walls, the rough and coarse workmanship is astonishing, in comparison with the exquisite masonry of the casing and entrance of the pyramid; and the variation in the measures taken shows how badly pyramid masons would work."[9]

Perhaps researchers are being somewhat hard on the masons who worked on the granite complex. After all, granite is an extremely hard material with which to work, and once the pyramid was closed up, who would see it? As Petrie noted, the casing stones and entrance passage of the pyramid were tooled to a remarkable closeness and fine finish. But then, that work is in a location where any deviation from the precision of which the workers were capable would be seen by all who passed by, reflecting badly on them. It is understandable that a worker, or group of workers, would produce the best work where it would be noticed and, perhaps, be less critical of it where it is hidden. But, as I said earlier, *everything* in the Great Pyramid has an explanation, and I believe my theory will adequately account for this variation in workmanship.

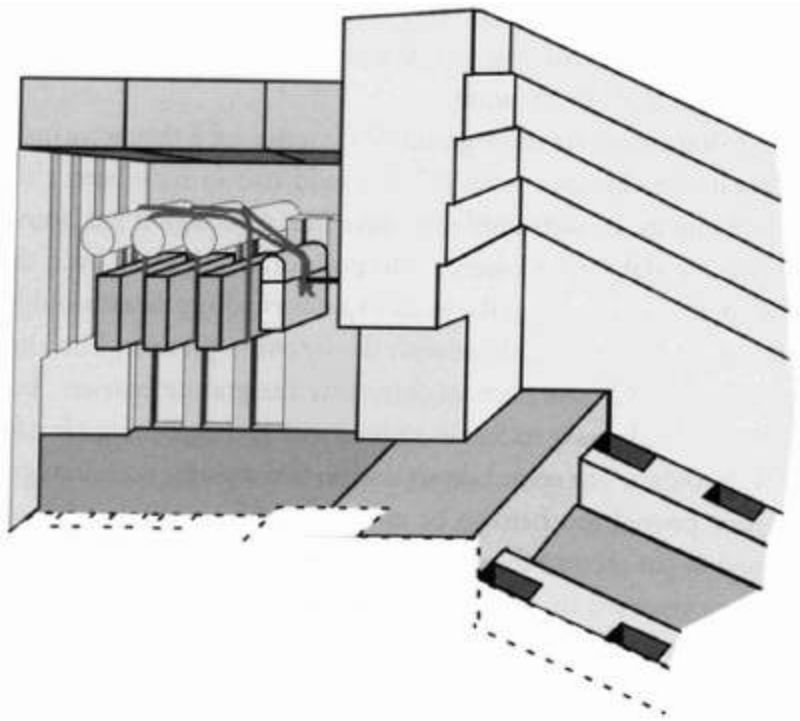


FIGURE 7. ***Borchardt's Theory on the Antechamber***

Even if a reasonable explanation for the less-than-perfect work in the Antechamber is accepted, the characteristics of the chamber still initiate a great deal of thought. Egyptologist Ludwig Borchardt theorized that this small chamber contained a mechanism that closed off the access to the King's Chamber after the funeral procession made its exit. This was supposedly accomplished by lowering granite slabs, suspended by ropes down the slots

located in the east and west walls of the chamber (see Figure 7).[10]

In explaining the "disappearance" of these slabs, Egyptologists claim they were removed by grave robbers. Once again, the poor old grave robber gets the blame! Of course, after digging the tortuous Well Shaft with such remarkable precision, and luckily finding himself in the Grand Gallery, nothing would be impossible for this ingenious thief. Still, what would a grave robber want with chunks of masonry? What possible value would granite chips have to someone with easy access to an abundance of masonry available on the outside of the pyramid?

In addition, how were those granite slabs removed if they were installed in the slots in the chamber walls? They would had to have been chipped away or lifted up in the slots until they were free. Although it has been conjectured that the slabs were lowered into position by ropes, or even the release of sand, it is unlikely that the means to reverse this process would have been left readily available to those with the intent to plunder. The alternative, therefore, would have been to chip away the granite barriers. But yet again, the remarkable grave robber is credited with accomplishing a feat found impossible by others. The record shows that on two separate occasions granite barriers have proved too hard to be cut away with simple hand tools. Al Mamun had to cut around the granite plugs in the Ascending Passage, and Howard-Vyse resorted to detonating gunpowder charges, for even in his modern time (as compared to the time of Al Mamun), an effective cutting tool for this granite was not available.

It is possible that, if the granite slabs were thin enough, they could have been broken by sheer pressure, but if the slots inside the Antechamber are any indication of the slabs' thickness, they would have been 21.6 inches thick, which is quite a hefty piece of stone. A conveniently located cleavage plane on each of the granite slabs might have enabled the grave robbers to break through, if they were able to apply the necessary pressure to the granite. Nevertheless, the very idea that granite slabs were once in place in the Antechamber is pure speculation. However—discounting the previous argument regarding the possibility of grave robbers breaking through to the King's Chamber—we can still respect the argument laid down by Piazzi Smyth:

These three grand, flat, vertical grooves, then, on either side of the narrow ante-chamber, have been pronounced long since by Egyptologists to be part of a vertical sliding portcullis system for the defense of the door of the King's Chamber. There are no blocks now to slide up and down these grooves, nor have such things ever been seen there: but the gentlemen point triumphantly to a fourth groove, of different order, existing to the north of all the others, indeed near the north-beginning of the ante-chamber; and with its portcullis block, they say, still suspended, and ready for work.

That alleged block, however, contains many peculiarities which modern Egyptologists have never explained; and as it was first carefully described by Professor Greaves under the appellation of the "granite leaf" (from the so-called "leaf" or "slat" or sliding door over the water-way of a lock-gate in an English navigation canal), we had better keep to that name.

Its groove, instead of being 21.6 inches broad, like the others is only 17.1 broad; and in place of being like them cut down to, and even several inches into, the floor, terminates 43.7 inches above that basal plane; so that the leaf's block, or rather blocks—for it is in two pieces, one above the other—stand on solid stone of the walls on either side, and could not be immediately lowered to act as a portcullis, though an Emperor should desire it. Nor would they make a good portcullis if they were to be forcibly pushed, or chiseled down in their vertical plane, seeing that there are 21 inches free end space between the leaf and the north entering wall and doorway, where a man may worm himself in, in front of that face of it ; and 57 inches above the leaf's utmost top, where several men might clamber over; and where I myself sat on a ladder, day after day, with lamps and measuring rods, but in respectful silence and generally in absolute solitude, thinking over what it might mean.[11]

Smyth's meditation on the Antechamber, its granite leaf, and the slots in the east and west walls left him resigned to a conclusion that does not seem to have been improved upon after the passing of a complete century. Writing in 1880, Smyth sagely concluded that "the granite leaf is, therefore, even by the few data already given, a something which needs a vast deal more than a

simple portcullis notion to explain it. And so do likewise the three broader empty pairs of grooves to the south of it, remarkable with their semi-cylindrical hollows on the west side of the chamber."[12]

How correct, then, are those theories that explain the existence of the Antechamber? Not very, for none adequately explains the indisputable amount of work that went into making it more than just a simple room with four walls, floor, ceiling, and two passageways. There must have been a reason for the additional effort expended in cutting the four slots in the chamber walls and installing a granite slab in an immovable position. As we will soon discover, one explanation that does explain the Antechamber is that it had a mechanical function. The evidence is plainly clear if one knows how to read it.

For example, the presence of half-round hollows in the top surface of the granite wainscot definitely suggests that cylindrical objects were at one time suspended across the width of the Antechamber and that these may have been receptacles for bearings, or were the bearing surfaces themselves. Again, Piazzi Smyth took careful notes:

> *. . . Little indeed is the ante-chamber, when it measures only 65.2 inches in utmost breadth from east to west, 116.3 long from north to south, and 149.4 high; but it has a sort of granite wainscot on either side of it, full of detail; and was to me so complicated and troublesome a matter as to occupy three entire days in measuring.*
>
> *On the east side, this wainscot is only 103.1 inches high, and is flat and level on the top; but on the west side it is 111.8 inches high, and has three semi-cylindrical cross hollows of nine inch radius, cut down into it, and also back through its whole thickness of 8.5 to 11.7 inches to the wall. Each of those semi-cylindrical hollows stands over a broad, shallow, vertical, flat groove 21.6 inches wide, 3.2 inches deep, running from top to bottom of the wainscot, leaving a pilaster like separation between them. The greater part of the said pilasters has indeed long since been hammered away, but their fractured places are easily traced; and with this allowance to researchers in the present day, the groove and pilaster part of the arrangement is precisely repeated on the east side, within its lower compass of height.*[13]

Is it conceivable that the pyramid builders went to such a great amount of trouble to cut this granite for a one-time operation? If this chamber was designed to be a closing mechanism, and it was to be activated only one time, it would not have been necessary to include such a complicated design and to cut that design out of such hard and durable material. Still, if we try our hardest to give this theory its due, we would have to admit that there are cases today where a tool or machine may be "over-designed" to do the work for which it was built. But we must be aware that for the Antechamber to find a parallel in modern industry, we would have to allow for an equivalent situation, such as an expensive die being built from the finest quality tool-steel, even though it would be used to produce only one part. The theory strains under the weight of such an unlikelihood.

Under the Egyptologists' present theories, the Antechamber is, indeed, a perplexing and contradictory inclusion in the design and building of the Great Pyramid. But there is a reasonable answer to this mysterious and puzzling feature of the Great Pyramid—it is a mechanical and technological answer that so far has not attracted any consideration.

Perhaps the clue to answering this question lies inside the King's Chamber, or perhaps above the King's Chamber in the superimposed "construction chambers." A thorough investigation of the King's Chamber by Petrie revealed that the chamber had, at one time, been subject to a violent disturbance, which had shaken it so badly that the entire chamber was caused to expand approximately one inch! The granite beams on the south end of the chamber were wrenched loose and cracked through, indicating a powerful destructive force. Petrie attributed this disturbance to an earthquake, which has been the general assumption since. In Petrie's words, "All these motions are yet but small—only a matter of an inch or two—but enough to wreck the theoretical strength and stability of these chambers, and to make their downfall a mere question of time and earthquakes."[14]

Here again something does not seem to add up. It has been accepted that an earthquake could be the only disturbing force affecting the King's Chamber, and yet we could bring the same argument into play here that we used to refute the speculation that the ancient guardians noticed subsidence on the outside of the pyramid. If an earthquake had disturbed the King's Chamber to the extent that several giant granite beams were cracked and the entire

chamber was expanded a whole inch, wouldn't it be reasonable to find similar disturbances elsewhere in the Great Pyramid? The King's Chamber is located 175 feet above ground level, and yet on the lower levels of construction, no similar disturbances have been noted. On the contrary! These areas show remarkable precision—a precision that has astounded those who have researched and measured the Great Pyramid and many who have subsequently studied those findings.

The King's Chamber, it appears, shows a greater amount of discrepancy than the entire thirteen-acre base of the pyramid! Why would an earthquake seek out one lonely chamber in a giant complex of masonry, passages, and chambers? The Queen's Chamber seems to have been unaffected by this catastrophic event. The Descending Passage—as mentioned earlier—is remarkably precise. No unusual disturbances were noted inside the Grand Gallery; even the Antechamber does not show the extent of damage suffered by the King's Chamber. More important, it is the specific characteristics of the disturbance that give rise to serious misgivings about the earthquake theory. Something caused the King's Chamber to expand! This small granite chamber, surrounded by a giant mass of limestone masonry, apparently pushed against that encompassing weight to the extent that the walls were moved outward from their original position. Petrie explained the damage:

> *The King's Chamber was more completely measured than any other part of the pyramid; the distances of the walls apart, their verticality in each corner, the course heights, and the levels, were completely observed. On every side the joints of the stones have separated, and the whole chamber is shaken larger. By examining the joints all round the second course, the sum of the estimated openings is 3 joints opened on N. side, total =.19; 1joint on E. =.14; 5 joints opened on S. = .41; 2 joints on W = .38. And these quantities must be deducted from the measure, in order to get the true original lengths of the chamber. I also observed, in measuring the top near the W, that the width from N. to S. is lengthened .3 by a crack at the S. side.*[15]

It would be interesting to find out what pressure would be needed to move the walls and affect the chamber this way, especially taking into consideration that all the spaces above the King's Chamber also were affected

by the disturbance. Petrie continues with his observations:

> *These openings or cracks are but the milder signs of the great injury that the whole chamber had sustained, probably by an earthquake, when every roof beam was broken across near the south side; and since which the whole of the granite ceiling (weighing some 400 tons) is upheld solely by sticking and thrusting. Not only has this wreck overtaken the chamber itself, but in everyone of the spaces above it are the massive roof beams either cracked across or torn out of the wall, more or less, at the south side; and the great eastern and western walls of limestone, between and independent of which, the whole of these construction chambers are built, have sunk bodily.*[16]

Several facts support the speculation that the guardians of the Great Pyramid were aware of the damage suffered by the King's Chamber. The hole Davison discovered, which in turn led to the discovery of the superimposed chambers above the King's Chamber, can be explained by surmising that the guardians carried out a close inspection of the damage affecting the upper levels of the granite complex. The guardians, after satisfying themselves that no further attention was required, terminated their inspection at that point.

Another point that satisfies this theory is an attempt to rectify, to some extent, some of the damage in the King's Chamber. Again Petrie related some pertinent facts concerning the ancient guardians' inspection: "The roofing beams are not of 'polished granite,' as they have been described; on the contrary, they have rough-dressed surfaces, very fair and true so far as they go, but without any pretence to polish. Round the S.E. corner, for about five feet on either side, the joint is all daubed up with cement laid on by fingers. The crack across the Eastern roof-beam has been also daubed with cement, looking therefore, as if it had cracked *before* the chamber was finished. At the S.W. corner, plaster is freely spread over the granite, covering about a square foot altogether."[17]

The cracks were evidently unacceptable to the guardians, and required the addition of a layer of plaster. The question that arises is, what purpose does a thin layer of plaster serve? It is doubtful that it would lend any structural improvement to the granite complex, for what could a thin layer of cement do

to prevent one of the forty-five-or seventy-ton granite beams above the King's Chamber from collapsing? Would the cement have been added to the cracked beams for some other purpose? Whatever the answer, it was evidently important enough that the Great Pyramid was entered, at the expense of a great deal of time and trouble, to make repairs.

If we could talk with those who entered the Great Pyramid to make these repairs, what would they tell us regarding the nature of the disturbance in the King's Chamber? And how would they explain the fact that the chamber had expanded? Would they confirm the earthquake theory? Or would they gently inform us that if an earthquake had indeed shaken the chamber, it would, in all probability, have collapsed? Furthermore, how would they explain their even knowing that such a disturbance had affected the well-insulated King's Chamber? Could they convince us that the minute variation from true level found in the base of the pyramid justified their effort in inspecting the small chamber at its heart? Let us face facts—the guardians would have a lot of explaining to do.

There are more questions raised by the King's Chamber. At first glance, it appears to be just a room made from red granite. As we look closer, though, it poses more mysteries than the rest of the chambers and passages of the Great Pyramid combined. While poking around the pyramid, John Greaves partially uncovered one of these mysteries.

Greaves was puzzled by the many features of the Great Pyramid that seemed to be inconsistent with any logical design for a tomb. The Grand Gallery was especially disturbing to this English mathematician and astronomer, whose mind was schooled in the orderliness of nature. He questioned that the Grand Gallery was built to serve as a stairway leading to the King's Chamber, for he had trouble making his way to the top. Its size, the corbeled walls, and the fact that it was built on such a steep angle did not indicate to him that it could have been used as a chamber either. Besides, in order to get to the Grand Gallery, he had to double over and squeeze his way through the Ascending Passage in much the same way as Al Mamun and his men did before him.

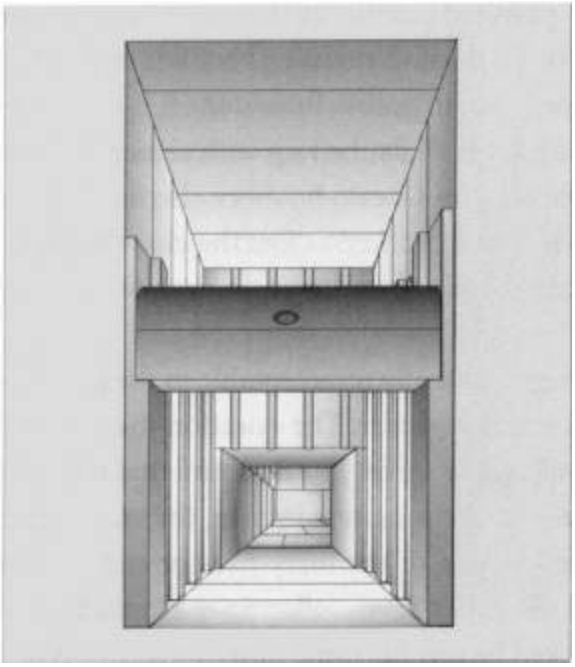


FIGURE 8. ***Antechamber***

At the end of the Grand Gallery, stooping to enter the passage that led to the Antechamber, Greaves was baffled by the "portcullis" entrance, and he wondered why the walls, floor, and ceiling suddenly changed from limestone to granite. He could not even begin to fathom the complex Antechamber (see Figure 8).

The passage leading from the Antechamber to the King's Chamber is actually smaller than the sarcophagus, or coffer, that sits within the chamber, so that would had to have been installed at the time the pyramid was under construction and before the ceiling beams over the King's Chamber were put in place. Regarding the King's Chamber, Greaves wondered why a single chamber, which housed a solitary, empty coffer, needed the protection of the tremendous amount of masonry that surrounded it. He questioned why a structure as huge as the Great Pyramid was necessary for a single burial.

What is more, in the King's Chamber, Greaves observed small openings in both the north and south walls. They were not given much attention at first, and were thought to be receptacles for candles or lamps. However, after Howard-Vyse's assistant, Perring, was almost decapitated when a stone shot out of one opening and barely missed his head, it became clear that the "lamp receptacles" were actually the lower ends of shafts that ran through the body

of the pyramid to the outside. The stone that almost injured Perring had evidently cleared some blockage in the shaft while it was making its way to the inner chamber, for immediately afterward a rush of cool air entered the chamber. It is reported that with the clearing of the shafts to the King's Chamber) the chamber maintained a constant temperature of 68° Fahrenheit, no matter what the weather or temperature was outside. This temperature is no longer constant because the tourists who go through the Great Pyramid nearly every day generate body heat and moisture. I have been left hot and sweaty each time I crawled through the Ascending Passage or climbed the Great Gallery. The problems associated with this elevation of temperature and humidity in the King's Chamber prompted the Egyptians to contract with Rudolph Gantenbrink, a German engineer, to install fans in the Northern and Southern Shafts to improve the circulation of air (see Figure 9).

FIGURE 9. ***Southern Shaft in the King's Chamber***

What purpose do these shafts serve? Imagine the difficulty of including these shafts in the construction of the pyramid. If they were intended to supply the King's Chamber with air, a simpler method of construction could have been used, for instance, following a horizontal path along a course of masonry to the outside. This alternative method probably would have resulted in greater airflow as well. Because of these considerations, and the fact that the dead do not breathe, Egyptologists believe that the shafts were not intended to ventilate the chamber at all, but were constructed purely for symbolic or cultic reasons.

In addition, there are significant technical problems associated with constructing the pyramid with the shafts on an incline. The limestone blocks that form the shafts on the north side would have needed precise compound angles on their adjoining faces as they turn to avoid the Grand Gallery (see Figure 10).

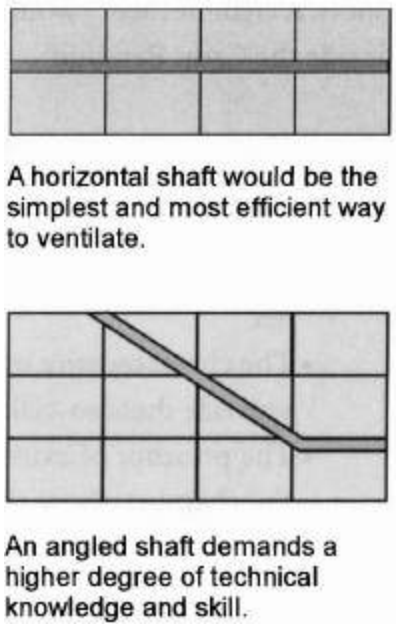

A horizontal shaft would be the simplest and most efficient way to ventilate.
An angled shaft demands a higher degree of technical knowledge and skill.

FIGURE 10. ***Horizontal Airshaft vs. Angled Airshaft***

When I was inside the Great Pyramid in 1995, I noticed an iron gate covering an opening in the passageway between the Grand Gallery and the Antechamber. The iron gate was unlocked, so I took the opportunity to climb into a small tunnel with my flashlight to see where it went. When I reached the end, I found myself looking at what remains of the Northern Shaft, and I was able to witness the quality of fit between those limestone blocks. As I swept the shaft with my light, I could see the fan that Gantenbrink had installed to ventilate the chamber. The shafts were exposed on the bottom side, and I was able to see that they were cleanly cut, with square, sharp inside corners. Knowing of the precision built into the rest of the pyramid, and into other ancient artifacts I had seen in Egypt, I was not surprised by the quality of workmanship—though having worked with compound angles where features of a component have to fit together without any mismatch, I could not help but be impressed. This kind of precision is not coincidental, and the builders would not have invested the resources necessary to cut and

construct this feature if there was not a real need for such precision. That likelihood in itself contradicts the symbolic or cultic reasons Egyptologists ascribe to the shafts. And besides, there are simpler ways of illustrating symbolism and cultism, such as the reliefs and paintings that the ancient Egyptians created with great skill.

Any theory about the Great Pyramid should both satisfy the demands of logic and provide answers for all the relevant discoveries that have promoted so much perplexity in the past. As we have seen in this chapter, current theories regarding the function and construction of the pyramid fall short. A credible theory would have to explain the following conditions found inside the Great Pyramid:

- The selection of granite as the building material for the King's Chamber. It is evident that in choosing granite, the builders took upon themselves an extremely difficult task.
- The presence of four superfluous chambers above the King's Chamber.
- The characteristics of the giant granite monoliths that were used to separate these so-called "construction chambers."
- The presence of exuviae, or the cast-off shells of insects, that coated the chamber above the King's Chamber, turning those who entered black.
- The violent disturbance in the King's Chamber that expanded its walls and cracked the beams in its ceiling but left the rest of the Great Pyramid seemingly undisturbed.
- The fact that the guardians were able to detect the disturbance inside the King's Chamber, when there was little or no exterior evidence of it.
- The reason the guardians thought it necessary to smear the cracks in the ceiling of the King's Chamber with cement.
- The fact that two shafts connect the King's Chamber to the outside.
- The design logic for these two shafts—their function, dimensions, features, and so forth.

Any theory offered for serious consideration concerning the Great Pyramid also would have to provide logical reasons for all the anomalies we have

already discussed and several we soon will examine, including:

- The Antechamber.
- The Grand Gallery, with its corbeled walls and steep incline.
- The Ascending Passage, with its enigmatic granite barriers.
- The Well Shaft down to the Subterranean Pit.
- The salt encrustations on the walls of the Queen's Chamber.
- The rough, unfinished floor inside the Queen's Chamber.
- The corbeled niche cut into the east wall of the Queen's Chamber.
- The shafts that originally were not fully connected to the Queen's Chamber.
- The copper fittings discovered by Rudolph Gantenbrink in 1993.
- The green stone ball, grapnel hook, and cedar-like wood found in the Queen's Chamber shafts.
- The plaster of paris that oozed out of the joints inside the shafts.
- The repugnant odor that assailed early explorers.

As I have said, there are reasons for everything, and each of the above items is assuredly the effect of some cause. When searching for a solution to the enigmas of the Great Pyramid, assuming that all other explanations do not satisfy us, we must take all the evidence into consideration, even the most seemingly trivial details. In the chapters that follow, I will examine these details to prove that even information that seems unimportant may have had a most significant cause, and what has previously received just a passing look by researchers may hold the key to solving the whole problem. Because current theories do not provide satisfying answers to the questions raised by the Great Pyramid, researchers continue to cut tunnels, dig passages, and probe the pyramid, using advanced electronic sounding devices in an attempt to acquire just one more secret. As my theory will show, however, answers to much of the mystery may lie in what already has been found.

Chapter Three

PRECISION UNPARALLELED

After reading considerable material on the subject of the Great Pyramid and studying the drawings that accompanied the texts, it appeared to me that the opponents of the tomb theory had a valid point. With this in mind, I looked more closely at what I considered to be the most significant information regarding the Great Pyramid, which was the accuracy with which it was built. It soon became obvious to me that the researchers on both sides of the issue were sympathetic to the craftspeople involved in building the pyramids. But the researchers were not craftspeople themselves, and they did not have the perspective gained through years of experience working with their hands and with machinery. Having that experience myself, I have some very strong opinions regarding the level of manufacturing expertise practiced by the ancient Egyptians. They were not primitive by any means, and their craftsmanship and precision would be an extreme challenge to duplicate today.

During my research on the Great Pyramid, and in considering the many questions raised by others, I began to form an opinion regarding the true purpose of this structure. The decision to write this book came about after careful consideration of what courses of action were available to me to share ideas I had developed regarding the pyramid and other artifacts described by Egyptologists, especially William Flinders Petrie. As a craftsman and engineer who has worked with close tolerances for more than thirty-five years, it was only natural for me to find great affinity with the people whose remarkable accuracy was evident in building this structure.

For readers not familiar with the issues of manufacturing, let me pause briefly to provide a short historical overview. The industrial revolution, which had its genesis in England in the early 1800s, brought about standardization in the manufacture of components. Take, for instance, the

rifle. At one time, each part of a rifle was manufactured and individually tailored to fit another part. There was no standardization of precision whereby interchangeable pieces could be taken off the shelf and appropriately fitted into the rifle without some adjustment. Each component was customized to fit with the other. Eli Whitney first proposed standardizing rifle components in order to facilitate supplies for war; however, in order to achieve standardization, unwelcome variations had to be worked out of the manufacturing process. In other words, it would be very unlikely that a shaft produced on a lathe that machined variations of .010 inch in diameter would precision-fit a bore with the same variations. Machines with greater precision were needed, along with a system of measurement hat was standardized and closely controlled to monitor the products produced by these machines.

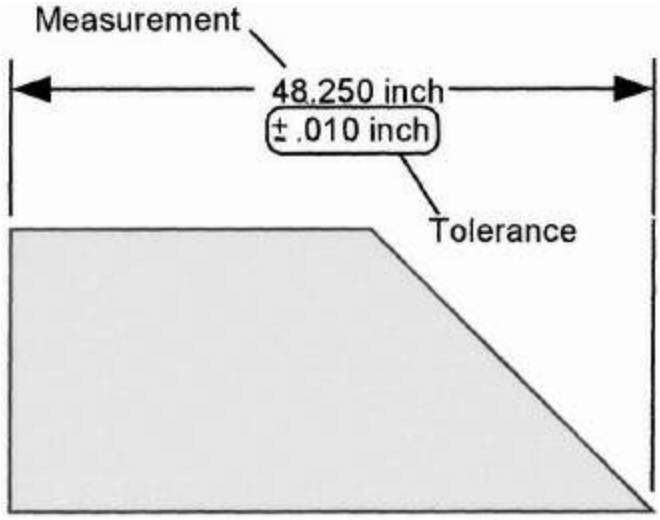
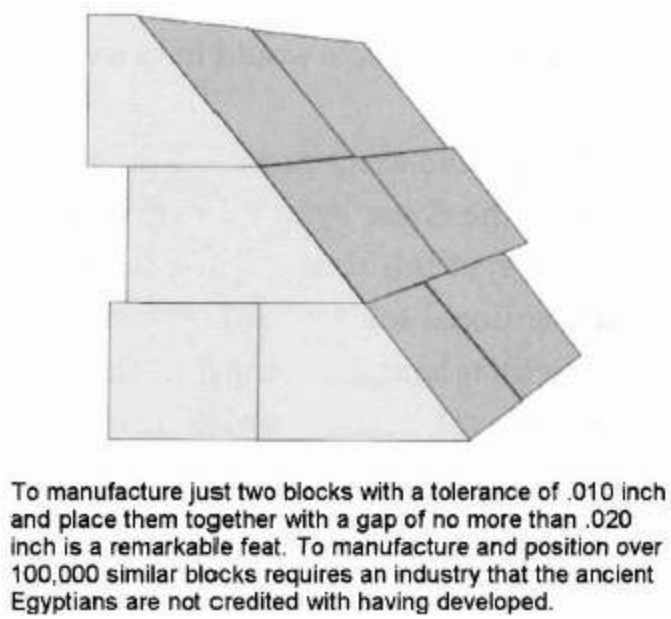


FIGURE 11. ***Measurement and Tolerance***

Metrology is the science of the use of measuring equipment that is closely calibrated and monitored. The equipment requires a greater degree of precision than the object that is being produced. That being the case, we are assured that the object conforms to specification. Normally a measuring instrument, or gauge, for checking the precision of a product has a tolerance of ten percent of the tolerance of the object (see Figure 11).[1] Although the accuracy exhibited in the Great Pyramid was recorded over a century ago, it would be helpful to reevaluate the findings of early explorers in the light of today's technology.

When Petrie made his critical measurements of the Great Pyramid casing

stones in 1882, he was astounded by what he found: "The eastern joint of the northern casing stones is on the top .020, .002, .045 wide; and on the face .012, .022, .013, and .040 wide. The next joint is on the face .001 and .014 wide. Hence the mean thickness of the joints is .020; and, therefore, the mean variation of the cutting of the stone from a straight line and from a true square, is but .010 on length of 75 inches up the face, an amount of accuracy equal to most modern opticians' straight edges of such length."[2]



To manufacture just two blocks with a tolerance of .010 inch and place them together with a gap of no more than .020 inch is a remarkable feat. To manufacture and position over 100,000 similar blocks requires an industry that the ancient Egyptians are not credited with having developed.

FIGURE 12. ***Casing Stones of the Great Pyramid***

Petrie's close examination of the casing stones revealed variations so minute that they were barely discernible to the naked eye. The records show that the outer casing blocks were square and flat, with a mean variation of 1/100 inch (.010) over an area of thirty-five square feet. Fitted together, the blocks maintained a gap of 0 to 1/50 inch (.020), which might be compared with the thickness of a fingernail. Inside this gap was cement that bonded the limestone so firmly that the strength of the joint was greater than the limestone itself. The composition of this cement has been a mystery for years.

The casing blocks were reported to weigh between sixteen and twenty tons each, with the largest blocks measuring five feet high, twelve feet long, and eight feet deep (see Figure 12).

It was these figures that greatly influenced my preliminary assessment of the pyramid. Here was a prehistoric monument that was constructed with such precision that you could not find a comparable modern building. More remarkable to me was that the builders evidently found it *necessary* to maintain a standard of precision that can be found today in machine shops, but certainly not on building sites.

These details are important, and we should consider them as we seek to determine how the ancient Egyptians quarried, dressed, and assembled those blocks. The general population of a century ago would not have fully appreciated the significance of such fine tolerances. At that time opticians were the only artisans who worked with such fine tolerances. Today, any researcher wishing to compare the skills found in the Great Pyramid with modern-day craftspeople would have a variety of skilled trades from which to choose.

Although the exact precision demonstrated in the manufacture and assembly of the Great Pyramid may have had little significance a century ago, there are, at this time, many people who are intimately familiar with these dimensional tolerances. I am one of them, for many years creating products with tolerances much finer than .010 inch. I know what it takes to hold such fine tolerances—and there is a great difference between knowing what .010 inch is from an abstract academic viewpoint and understanding what .010 inch is from hands-on, practical experience.

This is why I laugh when I hear intelligent men and women proposing that the pyramids and other artifacts were created using hammers and chisels. Other machinists, toolmakers, and engineers with whom I have discussed this issue are equally amused, and normally just shake their heads and mutter something straightforward and unprintable. These workers, the members of what we consider a highly advanced civilization, understand the following: It is very well to dream, speculate, and theorize, but when it comes to doing the work, we are generally brought down to earth and hard facts. The most efficient and economically minded designers and engineers are those who have experienced the manufacturing phase of their ideas and have worked on the bench and with the machines. These experiences lead them to be more realistic in their demands of skilled craftspeople.

Through my own experience in manufacturing, I have realized that theories

and ideas that seemed to work fine in my mind, or on paper, could be rendered unworkable when I actually tried to apply them. In much the same way, I have found that many theories regarding the building of the Great Pyramid are not supported with material proof, for no one, despite numerous attempts, has been able to duplicate the structure using the methods theorized to have been in place in ancient Egypt. These methods have been applied, with limited success, in building smaller structures, but they are not attempts to replicate the more difficult aspects of the building. A pyramid that is twenty-or fifty-feet tall and built with limestone blocks that weigh no more than two tons does not explain how the ancient pyramid builders raised seventy-ton blocks of granite to a height of two hundred feet. Scaling up a project does not necessarily follow a linear path, nor does it rely solely on a fixed set of assumptions. So the researchers' fifty-foot pyramid may not necessarily provide them with all the data necessary to calculate the requirements for building the Great Pyramid.

Again, let us look to a technology common to our own generation to present an example of using the wrong assumptions when scaling up a project. Take, for instance, the early development of industrial lasers. As physicists, electrical engineers, optical engineers, and mechanical engineers accomplished the development of high-powered industrial lasers, they made an assumption that because the laser did not apply any mechanical force to the workpiece, the machine did not have to be as sturdy as those used in conventional machining operations—such as milling or lathe turning—where tremendous mechanical forces exert pressure on the tool and the machine. Working in the laboratory with machine members (or stages) no longer than twelve inches, researchers proved this assumption correct. However, when they built a machine that was three or four times larger, they found that other forces—such as inertia—came into play, and they realized that the machine-tools that carried these lasers had to be equally as robust and as strong as conventional machines. The situation in which Egyptologists would find themselves, I believe, would be quite similar if they scaled up their demonstration pyramid to the dimensions and precision of the Great Pyramid.

People who spend their entire careers building things, either on a building site or in a manufacturing tool shop, will know of several ways to do a task. An Egyptologist's attempt to build a pyramid using primitive means may be

experimental archaeology, but because it is based on a technologically limited insight into the real significance of the Great Pyramid, it is not scientific; it only proves that what the researchers accomplished can be accomplished in the manner it was accomplished, nothing more. I applaud Dr. Mark Lehner's honesty in confessing that he had used steel tools and a front-end loader while building the demonstration pyramid for the WGBH/*NOVA* documentary *This Old Pyramid*.[3] I wonder, though, why that construction effort was cut from the film and we viewers never got to *see* it.

The most refreshing account of the talent possessed by the builders of the Great Pyramid can be seen in a video produced by Atlantis Rising Video. An interview with respected builder and architect James Hagan, who designed the Walt Disney shopping village in Lake Buena Vista, Florida, the concrete Sanford Stadium at the University of Georgia, and the impressive MARTA Five Points Central Station in Atlanta, reveals an architectural genius of modern times who uses every technique available for modern structures, yet is humbled by the creation of the Great Pyramid. Without pride or arrogance, his humility was combined with awe as he afforded the builders of the Great Pyramid the highest accolade one professional can bestow on another. "The Egyptians, or whoever built the pyramid." he said earnestly in his southern drawl, "they could build anything they want to!"[4] His comment becomes more significant when it is understood within the context he set forth, admitting that it would be impossible to build a Great Pyramid today using modern building methods, and, therefore, impossible by primitive methods. "The thing I am concerned about" he said, "are the elements of the construction, and how they came to be. These are the principles I am involved with in my world, and these are the principles I apply to the Great Pyramid." The precision built into the pyramid puzzled Hagan. He doesn't understand why this kind of precision would be necessary. Modern buildings do not require that kind of accuracy, so there is no reason to do it. "So why," he mused, "did they try to accomplish it is the first mystery." His hands-on, real-world experience is bolstered by innocent sincerity and respect that transcends the plethora of amateurs (compared to him) who profess to "know" how the pyramids of Egypt were built, and is credible support for those who still see a mystery in this edifice, and who are still seeking answers.

It is interesting how Hagan and I came to this point. In school we were both taught that the pyramids were the tombs of the Egyptian kings. After working many years in our respective technological fields, we became more aware of the construction challenges the Great Pyramid presented, and we could compare it with our practical experience. Others are not so fortunate. They must rely only on the experience and opinions of others. General knowledge of the Great Pyramid has been greatly influenced by traditional historical teachings, which are then carried into the popular media. However, the information I am focusing on in this book is not available in most popular works, and so the general population has little comparative data to work with as they evaluate Egyptologists' theories. In proposing methods of construction, academics have given little or no consideration to the fine tolerances maintained throughout the Great Pyramid's structure. They pass over the astounding accuracy of the Descending Passage's construction, or at best give it just cursory consideration (see Figure 13). These facts have not attracted the critical attention they deserve because there is a big difference between reading these figures in a book and the actual experience of having to maintain this precision in one's work.

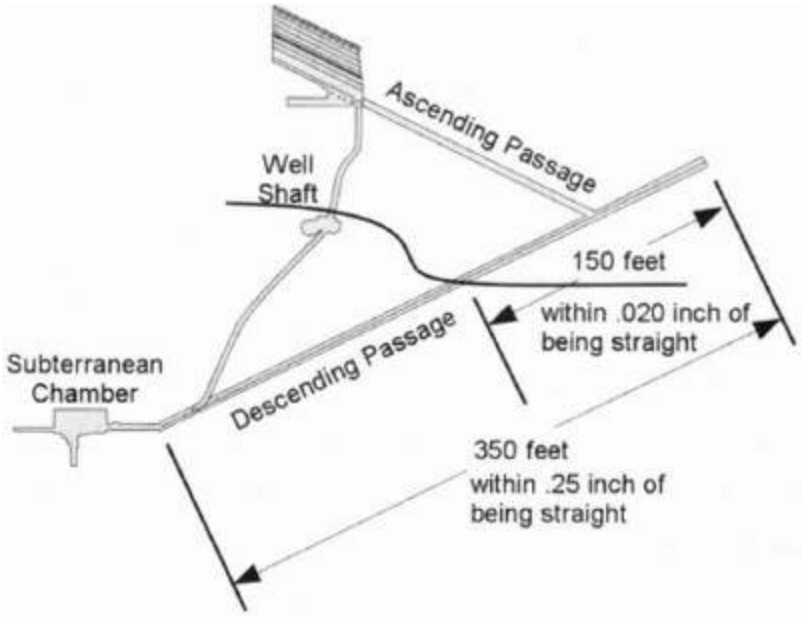


FIGURE 13. ***The Descending Passage***

Regarding the measurements taken by early explorers at the Great Pyramid and the possibility of duplicating this structure while maintaining similar

tolerances throughout, the many craftspeople with whom I have discussed these details disavow the primitive construction methods that Egyptologists propose. In my research, I had the opportunity to question modern stonecutters and find out the tolerances they work with. For instance, Indiana is famous for its limestone quarries—there are approximately thirty-three of them in and around Bedford—and they have a long history of providing limestone for many famous buildings, most notably New York's Empire State Building and the Waldorf-Astoria hotel.

At one time I lived sixty miles away from Bedford. One day I took an easy and pleasant drive through the picturesque southern Indiana countryside, which was ablaze with fall foliage, to talk to Tom Adams, who at that time worked at one of the quarries. Adams worked in the shop, cutting and dressing the stone, and the accuracy he was required to maintain in his work was not as stringent as for those who work with machine tools. Any craftspersons in a tool shop or machine shop can tell you exactly the tolerances they are working to. I asked Adams about the tolerances they work to in the quarries. He answered, "Pretty close." I asked, "How close is pretty close?" He responded, "Oh, about a quarter of an inch." Adams was astounded to hear that the limestone in the Great Pyramid was cut to .010-inch tolerance. His response regarding the abilities of the pyramid builders confirmed my belief that, contrary to what we have been taught, the pyramid builders were not primitive workers of stone.

It was clear to me that modern quarrymen and the ancient pyramid builders were not using the same set of guidelines or standards. They were both cutting and dressing stone for the erection of a building, but the ancient Egyptians somehow found it necessary to maintain tolerances that were a mere four percent of modern requirements. Two questions sprang from this revelation. Why did the ancient pyramid builders find it necessary to hold such close tolerances? And how were they able to consistently achieve them?

It goes without saying that if we were to build a Great Pyramid today, we would need a lot of patience. In preparation for his book *5/5/2000 Ice: The Ultimate Disaster,* Richard Noone asked Merle Booker, technical director of the Indiana Limestone Institute of America, to prepare a time study of what it would take to quarry, fabricate, and ship enough limestone to duplicate the Great Pyramid. Using the most modern quarrying equipment available for

cutting, lifting, and transporting the stone, Booker estimated that the present-day Indiana limestone industry would need to triple its output, and it would take the entire industry, which as I have said includes thirty-three quarries, *twenty-seven years* to fill the order for 131,467,940 cubic feet of stone.[5] These estimates were based on the assumption that production would proceed without problems. Then we would be faced with the task of putting the limestone blocks in place.

The level of accuracy in the base of the Great Pyramid is astounding, and is not demanded, or even expected, by building codes today. Civil engineer Roland Dove, of Roland P. Dove & Associates, explained that .02 inch per foot variance was acceptable in modern building foundations. When I informed him of the minute variation in the foundation of the Great Pyramid, he expressed disbelief and agreed with me that in this particular phase of construction, the builders of the pyramid exhibited a state of the art that would be considered advanced by modern standards.

In *Pyramid Odyssey*, William Fix stated that the most accurate survey of the base of the Great Pyramid showed it as 3023.13 feet around the perimeter, with the average of the sides being 755.78 feet. If the alignment of this structure was governed by today's building standards, then one side of the Great Pyramid would be allowed a variation of 15.115 inches.

The generally accepted academic theory on how the base of the Great Pyramid was leveled for the most part cannot account for this accuracy. Egyptologists propose that the area was leveled through the use of standing water: A grid-like system of canals was dug into the bedrock where the Great Pyramid was to stand, and then these canals were flooded. The dry rock, or bank of the canals, was cut level, using the surface of the water as a height gauge. Although there is no evidence to support this traditional theory, at first glance it does appear to have some elements of logic. If we believe that the pyramid builders were not sufficiently advanced to have developed the precision tools that are used by today's surveyors, that would seem to be the only method available to a primitive society. However, proponents of this theory sometimes fail to mention that there is an outcrop of bedrock that was left intact at the center of the pyramid. This would mean that any grid canals would have encircled the bedrock mound.

More importantly, another detail that so far has not been given any

consideration by proponents of this theory is: At what rate would the water in the grid canals system have been absorbed into the porous nummulitic limestone bedrock of the plateau, or have evaporated into the atmosphere? The grid system theory of leveling the base of the Great Pyramid is accepted on the premise that the standing water remained at a constant level in the canals. If such canals were indeed cut, how much water would be needed to reach a saturation point of the limestone plateau, which would be necessary for the water to remain at a certain level in the canals? The presence of fissures in the limestone possibly could be overcome by packing mud into them. However, this still does not explain why a primitive society, which had supposedly not yet invented the wheel, felt the need to build to such tolerances. If they did have that need and the grid system was the only method available to them, it would seem that this process would be so arduous and fraught with uncertainty that the very idea would be open to debate and promptly dismissed by the planners.

There is no evidence to support the theory that water channels facilitated the leveling of the Great Pyramid, and such a method does not seem very reliable. Mark Lehner proposed that a series of holes in the pavement around the Great Pyramid may have held sticks that were used as measuring devices, but this technique does not account for the pyramid's incredible precision. There is a modern instrument similar to that proposed by Lehner—it is called a transit, which is three sticks (a tripod) with a sophisticated measuring device on the top—but even with this instrument modern builders are not required to achieve such precision.

There is evidence that shows that ancient Egyptian builders used mechanical means to remove material in order to level the limestone bedrock for the foundation of various structures. In *Pyramids and Temples of Gizeh*, Petrie noted, "At El Bersheh (lat. 27°42') there is a still larger example, where a platform of limestone rock has been dressed down, by cutting it away with tube drills about 18 inches in diameter; the circular grooves occasionally intersecting, prove that it was done merely to remove the rock."[6]

Petrie's observations strongly support the speculation that the ancient Egyptians did not carry out their work with painstaking, back-breaking labor, but completed it with speed and precision through the employment of tools that would not be out of place on today's building sites. It certainly makes

sense to cut away excess material by using a rotating "drill" and working it down to a preselected required depth. These methods of removing excess material are common in machine shops today. Therefore, it could be suggested that as far as foundation laying goes, the ancient Egyptians had reached a finite state of the art, where there was little room for improvement.

From their precisely leveled plateau, the ancient pyramid builders raised a mountain of limestone and granite with the same care and precision with which they laid its foundation. The estimated height of the Great Pyramid is 480.95 feet. It is estimated to weigh 5,300,000 tons and contain 2,300,000 blocks of stone. The stones that makes up the bulk of the pyramid are limestone, which was quarried locally on the plateau itself and in the Mokattam Hills across the Nile River, twenty miles away. The inner stones are poorer quality and are known as nummulitic (nummulitic is used to describe round fossil shells; it literally means "coin-shaped"). The composition of the stone is calcium carbonate ($CaCo_3$),whichisanimportantfact to remember when we later look at the evidence that supports my theory.

The quantity of stone that had to be quarried, hauled, and hoisted into place in the Great Pyramid becomes even more impressive when it is compared with other civil engineering feats, whether real or imagined. It has been stated that it contains more stone than that used in all the churches, cathedrals, and chapels built in England since the time of Christ. Thirty Empire State Buildings could be built with the estimated 2,300,000 stones. A wall three-feet high and one-foot thick could be built across the United States and back using the amount of masonry contained in the Great Pyramid. The list of such comparative observations is long and could fill many pages, but these few suffice to impress upon us the prodigious feat the ancient builders accomplished.

The Great Pyramid's orientation is as impressively precise as its construction. It is oriented within three minutes of a degree from true north. Researchers speculate that because the pyramid was built 4,800 or more years ago, this variation may have been caused by a shifting of the Earth's crust or of its axis. Whatever the reason for its slight deviation from absolute true north, the Great Pyramid was the most accurately aligned structure in the world until the building of the Paris Observatory.

Adding to the mystery of the Great Pyramid is the fact that its shape appears to incorporate the mathematical function of pi. This incommensurable number, 3.14159 ad infinitum, exists in a pyramid when the angle of the pyramid's sides is 51° 51'14" per side. Given such an angle, the perimeter of the pyramid is in relationship to its height as the circumference of a circle is to its radius. It may be stretching the truth a little to say that the Great Pyramid had this exact angle, or that it was the builders' expressed intention to have a structure that exhibited this mathematical constant. Still it was certainly close. Petrie's measurements unequivocably show that the angle of the sides of the pyramid was constructed with remarkable precision. He wrote, "On the whole, we probably cannot do better than take 51° 52' plus or minus 2' as the nearest approximation to the mean angle of the pyramid, allowing some weight to the South side."[7] Having worked with blueprints where tolerances on angles are frequently given as plus or minus one degree unless otherwise specified, I am certain that Petrie's measurements indicate that the angle of the Great Pyramid was a critical part of the entire structure.

As we can see, there is four minutes of a degree tolerance band within which anybody so desiring could arrive at the perfect pi angle of 51°51'14". This angle fits well within the tolerance band described by Petrie, and if we wanted to choose this particular figure to prove that the builders had the knowledge of pi, we could probably do so. I prefer to present the data as Petrie did, with deviations that are bound to arise over such a large area. Although the incorporation of pi into the shape of the Great Pyramid has been attributed by some to be pure chance, the fact that such an angle was discovered in the casing stones suggests that the builders were at least knowledgeable in the sciences of mathematics, trigonometry, and geometry.

The enigmatic Great Pyramid initiates many very basic questions. Why is it so big? Why was it necessary to build it with such a high degree of accuracy? How was it built? Methods of transporting materials to the building site are still under debate. There have been attempts to vindicate traditional theories by following the methods that were proposed in building the pyramids. However, it could be said that hauling or dragging blocks of stone over the desert floor—just to prove that it can be done—does as much to prove that this was the way the blocks were moved as the apprentice toolmaker

perspiring over his deburring work proves that his efforts explain the entire General Motors operations, or the Nippon Corporation of Japan.

It is difficult to ascertain what the Japanese Nippon Corporation was trying to prove when, in 1978, they attempted to erect a sixty-foot pyramid in Egypt. Under prescribed conditions, they received permission from the Egyptian government to erect a pyramid southeast of Mycerinus' Pyramid on the Giza Plateau. They were to use the same methods that the original pyramid builders supposedly used. They were not to use the stone from the plateau itself, but from the quarry that provided the original blocks. The rules were that after Nippon had finished this demonstration, they were to dismantle their pyramid and restore the site to its original condition.

Agreeing to these stipulations, the Japanese set to work quarrying, hauling, and erecting approximately one-ton blocks of limestone. The reports and films taken of this operation reveal the difficulties they encountered during their long and difficult task. Reportedly, their first difficulty was getting the stones across the Nile River. In *Pyramid Prophecies,* Max Toth wrote:

> *Once cut into approximate one-ton blocks, the stones could not be barged across the River Nile. Floatation apparently was not the simple answer, as had been suggested. The blocks finally had to be ferried across by steamboat.*
>
> *Then, teams of one hundred workers each tried to move these stones over the sand—and they could not move them even an inch! Modern construction equipment had to be resorted to, and once again, when the blocks of stone were finally brought to the building site, the teams could not lift their individual stones more than a foot or so. In the final construction step, a crane and helicopter were used to position the blocks.*[8]

The reported difficulty the Japanese encountered moving the limestone seems to conflict with other reports by Egyptologists. According to I.E.S. Edwards, moving a one-ton block of limestone was not as difficult as the Japanese made it out to be:

> *Without wheeled vehicles, how did the Egyptians move such great weights, and how did they raise them to the heights of the pyramids at*

Giza? In an experiment not many years ago, a French investigator obtained a one-ton block of limestone. The block was positioned on a track of moist mud taken from the Nile, and a crew of about 50 men was assembled and instructed to pull it with ropes. When they started pulling, the block slid along as if it were almost weightless. With half as many men, the block again ran away. The experimenter soon found that one man, with no difficulty, could push the ton of stone along on the wet mud. In ancient records we see Egyptian crews dragging great weights on sledges while waterbearers wet down the surface ahead.[9]

Being objective about the whole debate of whether the methods of building the pyramids were those proposed by Egyptologists or other more advanced methods, and considering the experiments undertaken to obtain conclusive proof one way or another, we would have to question the motives of the experimenters. It seems that if the Japanese team were out to prove that pyramid building should be left to those with access to modern techniques and equipment, they succeeded. But this does not mean that their conclusions were irrefutable, and it does appear that they gave up easily when trying to move *their* one-ton blocks of limestone. However, the records show that they did attempt the construction of a pyramid (one that was small compared to the originals) and failed to complete it using primitive methods. It now remains for those who are absolutely convinced that the ancient Egyptians constructed the pyramids using primitive techniques to build a pyramid themselves, using those same techniques that they propose the Egyptians used. As part of such an attempt, it would help if they cut out just one seventy-ton block of granite from the Aswan quarry, which is located five hundred miles away, using their hardened copper chisels or dolerite balls and then transported the block to the Giza Plateau with their barges, ropes, and manpower. If the proponents of traditional theories of constructing the pyramids are able to accomplish this feat, then we should give serious consideration to their proposals about pyramid construction.

A more recent attempt at building a pyramid was carried out by a team from the television program *NOVA* that included Egyptologist Mark Lehner and Massachusetts stone mason Roger Hopkins. Their pyramid reached a height of twenty feet and took three weeks to build using steel tools, and

front-end loaders, and the valiant effort of laborers, who, under the direction of Hopkins and for the benefit of the cameras dragged the final stones into place. As Dr. Lehner honestly described the small scale of this undertaking, "It would have fitted neatly on to the top of the Great Pyramid, in whose shadow we built it."[10]

Considering the immense size of the Great Pyramid, the precision with which it was built, the materials that were used, and the uniqueness of its interior passages and chambers, we are faced with a structure that has no parallel in modern times. Theories of primitive methods of construction are invalidated by the proponents' own tests and demonstrations; and considering the time in which the proponents of these theories have had to develop a watertight case, it appears they will never figure it out. The passing years have significantly weakened the traditional views, perhaps not in the eyes of Egyptologists, but certainly in the eyes of people like myself. We are beginning to learn the true significance of alternative theories that have, for the most part, been ignored. Meanwhile, credibility of the old theories has been undermined by highly questionable armchair speculations that are passed on as facts—such as the idea that the Egyptians used copper chisels to shape hard, igneous rock.

The most compelling evidence for the likelihood that the Great Pyramid was constructed by craftspeople with specialized knowledge and advanced techniques is the precision with which it was built. This precision reveals more about the true nature of its builders than any inscription or cartouche. There is no way to ignore the accuracy of this stonecutting, despite Egyptologists' interpretations of the inscriptions found in pyramids or temples in Egypt. After all, hieroglyphics, like any language, has the potential to be misunderstood.

After discussing much of the preceding information with the artisans at today's building sites, machine shops, and quarry mills, I became aware of the reason why we are still influenced by ideas that are not compatible with practical application. The artisans of today are too busy making a living to give serious thought to scholarly theories, and even when gross inequities are presented to them, they respond with a cynical shrug. When told that giant limestone casing stones, which were cut to within 1/100 of an inch, were cut with hammer and chisel, a typical response was a shake of the head.

As for the general public's lack of interest in the technological mysteries surrounding the Great Pyramid, the fact is that the majority enjoy the use of technology without regard to its creation. We buy tools, utensils, and appliances with little thought about the skill and ingenuity that played a part in the production of just one little component. We appreciate the final product but have little knowledge of how it was made.

Because I have had technical experience in the procedures that created some modern conveniences, I have examined the evidence in a new way and I sum up my thoughts regarding the construction of the Great Pyramid as follows: It has been said many times that the Great Pyramid was built with tolerances that modern opticians would be hard-pressed to match. In analyzing the reason for this high degree of perfection, I consider two possible alternative answers. First, the building was for some reason *required* to conform to precise specifications regarding its dimensions, geometric proportions, and its mass. As with a modern optician's product, any variation from these specifications would severely diminish its primary function. In order to comply with these specifications, therefore, greater care than usual was taken in manufacturing and constructing this edifice. Second, the builders of the Great Pyramid were highly evolved in their building skills and possessed greatly advanced instruments and tools. The accuracy of the pyramid was normal to them, and perhaps their tools were not capable of producing anything less than this superb accuracy, which has astounded many over the years. Consider, for example, that the modern machines that produce many of the components that support our civilization are so finely engineered that the most inferior piece they could turn out is more accurate than what was the norm for those produced one hundred years ago. In engineering, the state of the art inevitably moves forward.

Of course, there might be a third alternative. It could always be said that those who built the Great Pyramid did not really know what they were doing, and that the end result of their labors was achieved purely through trial and error—the Great Pyramid's precision was just a stroke of luck. Yes, I know that reasoning sounds ridiculous, but it has been suggested by Egyptologists and other researchers, actually more than a few times. If we pass the achievement of the builders of the Great Pyramid off as pure coincidence, we need say little more. However, if curiosity gets the better of us, we can look a

little more closely and consider the notion that perhaps there is some significance behind the Great Pyramid's mathematical sophistication.

Today we do not invest the time and effort to finish modern artifacts to a precision of .0002 inch, unless we must. As a general rule, when estimating the cost of manufacturing an object, if the tolerance box has an extra zero in it —that is, not .001 but .0001—the price of the object increases significantly. The more precise the object, the more it costs, because the labor is more expensive. Tool and instrument makers earn more money per hour than machine operators. Therefore, it follows that for cost purposes, an engineer will design a machine or tool with the greatest amount of tolerance allowable while at the same time still providing for the machine's or tool's proper function. The measurements of any given object are simply a means to an end, and, while being related to the object, they are not the object itself. It is not unreasonable for us to assume, then, that the dimensions and precision embodied in the Great Pyramid are means by which the builders created a product that had to function in a way that a product of lesser precision could not.

If the builders were intelligent enough to figure out the engineering aspects of quarrying, hauling, and erecting millions of tons of masonry with such precision, then is it logical to assume that this feat was achieved with primitive methods? Would the degree of practicality evident in the structure have been limited to just the comprehension of its final form, or would it have been applied to solving all constructional aspects? Wouldn't any group of individuals who could build such an advanced and unique product have the capacity to develop advanced and unique tools to produce it? With the Great Pyramid, the achievement of its final form was undoubtedly a group effort; and since the evidence available suggests the builders used sophisticated methods of machining, they would have developed the necessary advanced and unique tools to do the job. With this in mind, perhaps we should speculate that they also had an advanced and unique purpose for building the Great Pyramid.

As I have suggested, if we look at the history of manufacturing, we will find that the evolution of machine tools has resulted in a quality of product that was not possible one hundred years ago. The accuracy and repeatability of these machine tools is such that the accuracy and replicability of some of

the work they produce may not be necessary for the product to function properly. The machines are built to produce highly accurate and consistent products without regard to the level of importance each feature may have in the final product. One viewpoint may be, therefore, that the pyramid builders had created machinery with a "state of the art" in cutting and dressing stone that was incapable of producing low-quality work. This may seem a far-fetched idea on the surface, but as I will show in the next chapter, advanced methods of machining stone are clearly evident in artifacts from that period.

With the Great Pyramid, we are faced with an artifact that exhibits a state of the art in manufacturing and construction that we do not find necessary for specification of modern buildings. In fact, artisans who provide materials and erect modern buildings do not even relate to the tolerances that must have been imposed on the creators of the Great Pyramid. It was with this realization that I continued my study and tried to imagine what recreating it would take. The Great Pyramid speaks of a highly skilled and intelligent body of people who conceived and executed a design with an attention to detail that is utterly astounding. A tremendous amount of resources must have been made available for it. Graham Hancock said it very nicely in a documentary I had taken part in. "The builders of the pyramids speak to us across the centuries and say 'We are not fools. . . . Take us seriously!'"[11] His comment sums up exactly the conclusions I had reached in 1977: The pyramid builders were as intelligent as we are. How they applied their knowledge may have been different, but it is obvious that they possessed sufficient knowledge to create an artifact having a distinct feature that, so far, we have not been able to repeat. The bald fact is that the Great Pyramid—by any standard old or new—*is the largest and most accurately constructed building in the world.*

The discoveries at the Great Pyramid that have most interested me are those that involve the methods the ancient builders used to cut the material used to construct it—primarily the granite. Because I am involved in manufacturing, I have noticed many inconsistencies between what Egyptologists have taught regarding the tools that were supposedly used and the evidence that can be drawn from the masonry itself. In other words, the stones of the Great Pyramid tell me a different story than they have other observers. The stones tell me that they were cut using *machine-power*, not manpower as orthodox

Egyptologists theorize.

Chapter Four

ADVANCED MACHINING IN ANCIENT EGYPT

In August 1984, Analog *magazine published my article, "Advanced* Machining in Ancient Egypt?" It was a study of *Pyramids and Temples of Gizeh* by Sir William Flinders Petrie. Since the article's publication, I have visited Egypt twice, and with each visit I leave with more respect for the ancient pyramid builders. While in Egypt in 1986, I visited the Cairo Museum and gave a copy of my article, along with a business card, to the director of the museum. He thanked me kindly, threw it in a drawer to join other sundry material, and turned away. Another Egyptologist led me to the "tool room" to educate me in the methods of the ancient masons by showing me a few cases that housed primitive copper tools. I asked my host about the cutting of granite, for that was the focus of my article. He explained that the ancient Egyptians cut a slot in the granite, inserted wooden wedges, and then soaked them with water. The wood swelled, creating pressure that split the rock. Splitting rock is vastly different than machining it, and he did not explain how copper implements were able to cut granite, but he was so enthusiastic with his dissertation that I did not interrupt. To prove his argument, he walked me over to a nearby travel agent, encouraging me to buy airplane tickets to Aswan, where, he said, the evidence is clear. I must, he insisted, see the quarry marks there, as well as the unfinished obelisk (see Figure 14).

Dutifully, I bought the tickets and arrived at Aswan the next day. (After learning some of the Egyptian customs, I got the impression that this was not the first time that my Egyptologist friend had made that trip to the travel agent.) The quarry marks I saw there did not satisfy me that the methods conventional theorists describe were the only means by which the pyramid builders quarried their rock (see Figure 15). For example, located in the channel which runs the length of the estimated 3,000-ton obelisk, I saw a

large, conical hole drilled into the bedrock hillside that measures approximately twelve inches in diameter and three feet deep. The hole was drilled at an angle, with the top intruding into the channel space (see Figure 16). To my eye, it seemed likely that the ancients might have used drills to remove material from the perimeter of the obelisk, knocked out the webs between the holes, and then removed the cusps.

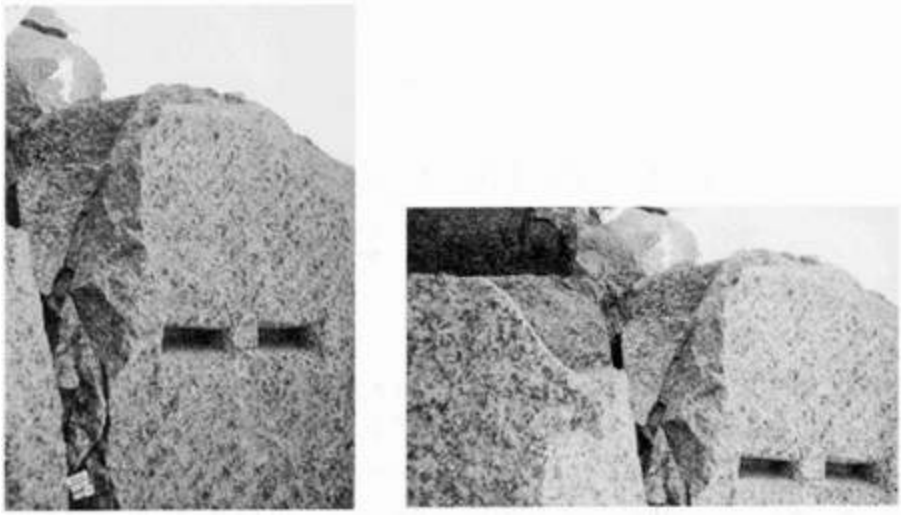


FIGURE 14. ***Quarry Marks at Aswan***

The Aswan quarries *were* educational, although after returning to Cairo the following day and while strolling around the Giza Plateau later in the week, I started to question the quarry marks at Aswan even more. South of the Second Pyramid I found an abundance of quarry marks of similar nature. The granite casing stones that had sheathed the Second Pyramid were stripped off and lying around the base in various stages of destruction. Some of the stones were still in place, though sections had been split away from them, and there I found the same quarry marks that I had seen earlier in the week at Aswan. This was puzzling to me. Disregarding the impossibility of Egyptologists' theories on the ancient pyramid builders' quarrying methods, I wondered if these theories were valid even from a nontechnical, logical viewpoint. If those quarry marks distinctively identify the people who created the pyramids, why would they engage in such a tremendous amount of extremely difficult work only to destroy the work after having completed it? It seemed to me that the quarry marks at Aswan and on the Giza Plateau were made at a later time and that they were created by people who were interested only in

obtaining granite without caring about its source.

FIGURE 15. ***Quarry Marks on Khafre's Pyramid Granite***

FIGURE 16. ***Drill Hole at Aswan***

As I pondered this revelation, I wondered about William Flinders Petrie, who had walked this plateau one hundred years before me. What drove him? What were his private thoughts about his studies that he did not share with the Royal Society or his colleagues? Being a pioneer in the field of Egyptology, his work greatly influenced the archaeological profession. It goes without saying that-archaeology is largely the study of history's toolmakers, and that archaeologists understand a society's level of advancement from its tools and artifacts. The hammer was probably the first tool ever invented, and hammers have forged some elegant and beautiful artifacts. Ever since humans first learned that they could effect profound changes in their environment by applying force with a reasonable degree of accuracy, the development of tools has been a continuous and fascinating aspect of human endeavor. The Great Pyramid, however, leads a long list of artifacts that have been misunderstood and misinterpreted by archaeologists, who have promoted theories and methods about its construction that cannot be explained using the tools they have excavated.

For the most part, archaeologists consider the primitive tools they discover as contemporaneous with the artifacts of the same period. During the pyramid building period in Egyptian history, artifacts were produced in prolific numbers and a great many have survived—but there are precious few tools that survive to explain their creation. Consequently, the ancient Egyptian artifacts cannot be explained in simple terms. What is more, the tools that *have* survived do not fully represent the state of the art that is evident in the artifacts themselves. The tools displayed by Egyptologists as instruments for the creation of many of these incredible artifacts are physically in capable of reproducing them. After standing in awe before these engineering marvels, and then being shown a paltry collection of copper implements in the tool case at the Cairo Museum, I came away bemused and frustrated. In spite of ancient Egypt's most visible and impressive monuments, we have only a sketchy understanding of the full scope of its technology.

Petrie recognized that these tools were insufficient to explain Egyptian artifacts. He explored this anomaly thoroughly in his book, and he expressed amazement about the methods the ancient Egyptians used to cut hard, igneous rocks. He credited these ancient craftspeople with methods that we

are only now beginning to appreciate. So why do modern Egyptologists insist that this work was accomplished with a few primitive copper instruments?

I am not an Egyptologist, I am a technologist. I do not have much interest in who died when, whom they may have taken with them, and where they went. I intend no disrespect for the mountain of work and the millions of hours of study conducted on this subject by intelligent scholars (professional and amateur), but my interest—thus my focus—is elsewhere. When I look at an artifact to investigate how it was manufactured, I am not concerned about its history or chronology. Having spent most of my career working with the machinery that actually creates modern artifacts—such as jet-engine components—I am able to analyze and determine how an artifact was created. I also have had training and experience in various nonconventional manufacturing methods, such as laser processing and electrical discharge machining. Having said this, I should state that, contrary to some popular speculations on the cutting of stone for the pyramids, I have *not* seen evidence of laser cutting on the Egyptian rocks. A variety of people have speculated that to erect a structure as perfect as the Great Pyramid, the builders must have possessed supernatural powers. Some even speculate that the builders used lasers to cut the masonry and then levitated the stones into place in the pyramid. While I cannot speak authoritatively regarding the builders' powers of levitation—whether the implementation of those powers was through the use of the mind or through the use of technology—I can say with reasonable confidence that no lasers were used in cutting the materials that went into building the Great Pyramid. Although the laser is a wonderful tool with many uses, its function as a cutting tool is limited to economically viable applications, such as cutting small holes in thin pieces of metal and refractory material. As a general purpose cutting tool, it cannot compete with the machining methods that were available before its inception.

Still, there *is* evidence for other nonconventional machining methods, as well as more sophisticated, conventional type sawing, lathing, and milling practices. Undoubtedly some of the artifacts that Petrie studied were produced using lathes. There is also evidence of clearly defined lathe tool marks on some "sarcophagi" lids. The Cairo Museum alone contains evidence—once it is properly analyzed—that is sufficient to prove that the ancient Egyptians used highly sophisticated manufacturing methods. For

generations scholars have focused on the nature of the cutting tools used. But while in Egypt in February 1995, I, as a technologist, discovered evidence that raises a perhaps more intriguing question: "What guided those cutting tools?"

The methods used to cut the masonry for the Great Pyramid can be deduced from the marks they left behind on the stone. The bulk of the pyramid was constructed with limestone blocks weighing an average of two-and-one-half tons each. While there are some interesting points to be made concerning the limestone that encased the Great Pyramid, and they will be addressed later, those stones do not offer the same information about the methods that were used to produce them as do the thousands of tons of granite. At the expense of considerable time and effort by the original creators, the granite artifacts found in the Great Pyramid and at other sites in Egypt offer the clues we are seeking.

But before we investigate the granite that was used in the Giza pyramids, we must evaluate several artifacts that almost undeniably indicate machine power was used by the pyramid builders. Those artifacts, scrutinized by Petrie, are all fragments of extremely hard, igneous rock. Those pieces of granite and diorite exhibit marks that are the same as those that result from cutting with modern machinery. It is shocking that Petrie's studies of those fragments have not attracted greater attention, for there is unmistakable evidence of machine-tooling methods. It will probably surprise many people to know that evidence proving that the ancient Egyptians used tools such as straight saws, circular saws, and even lathes *has been recognized for over a century.* The lathe is the father of all machine tools in existence, and Petrie submitted evidence showing that the ancient Egyptians not only used lathes, but they performed tasks that would, by today's standards, be considered impossible without highly developed specialized techniques, tasks such as cutting concave and convex spherical radii without splintering the material.

While digging through the ruins of ancient civilizations, would archaeologists instantly recognize the work of machine tools by the kind of marks made on the material or the configuration of the piece at which they were looking? Fortunately, one archaeologist had the perception and knowledge to recognize such marks, although at the time Petrie's findings were published the machining industry was in its infancy. The growth in the

industry since then warrants our taking a new look at his findings. (See Appendix A for an excerpt from Petrie's *Pyramids and Temples of Gizeh* regarding this topic.)

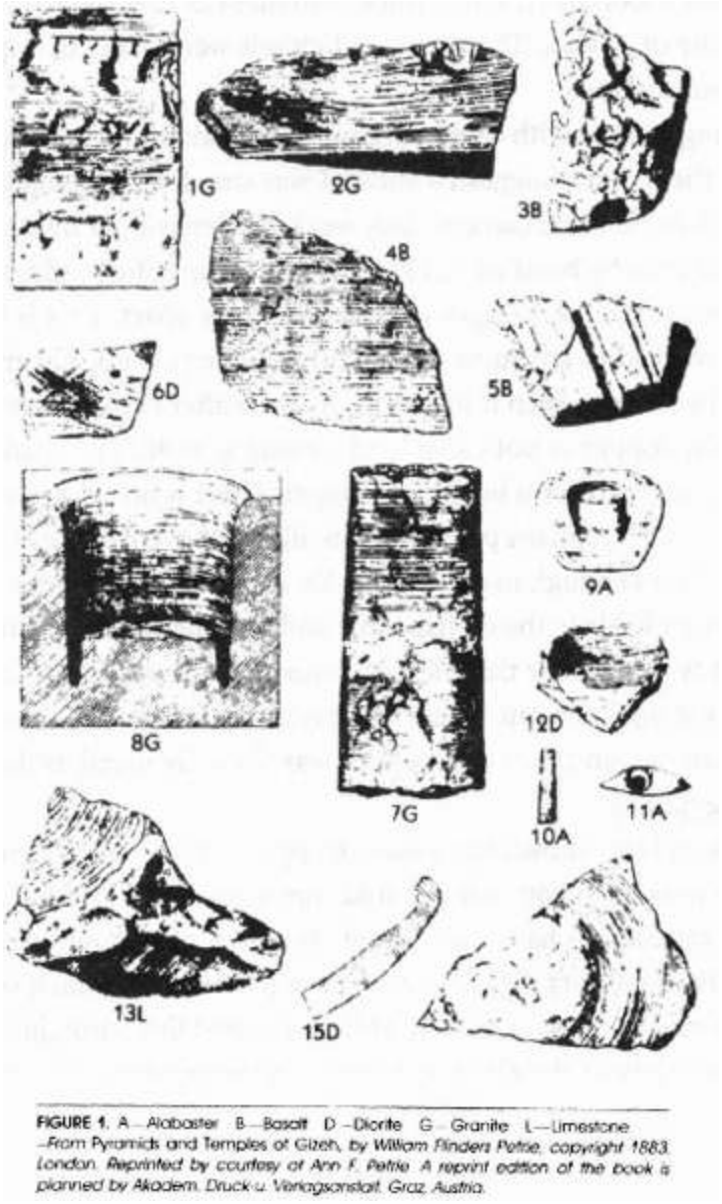


FIGURE 1. A—Alabaster B—Basalt D—Diorite G—Granite L—Limestone —From Pyramids and Temples of Gizeh, by William Flinders Petrie, copyright 1883, London. Reprinted by courtesy of Ann F. Petrie. A reprint edition of the book is planned by Akadem. Druck-u. Verlagsanstalt, Graz, Austria.

FIGURE 17. ***Petrie's Samples of Machining***

One can gather by reading Petrie's work that he involved himself in some extensive research regarding the tools that were employed in cutting hard stone (see Figure 17). Even so, there is a persistent belief among some Egyptologists that the granite used in the Great Pyramid was cut using copper chisels. I.E.S. Edwards, British Egyptologist and the world's foremost expert

on pyramids, said, "Quarrymen of the Pyramid age would have accused Greek historian Strabo of understatement as they hacked at the stubborn granite of Aswan. Their axes and chisels were made of copper hardened by hammering."[1]

Having worked with copper on numerous occasions, and having hardened it in the manner suggested above, I was struck that this statement was entirely ridiculous. You can certainly work-harden copper by striking it repeatedly or even by bending it. However, after a specific hardness has been reached, the copper will begin to split and break apart. This is why, when copper is worked to any great extent, it has to be periodically annealed, or softened, in order to keep it in one piece. Even after being hardened in this manner, the copper is not capable of cutting granite. The hardest copper alloy in existence today is beryllium copper. There is no evidence to suggest that the ancient Egyptians possessed this alloy, but even if they did, even this alloy is not hard enough to cut granite. Yet copper has been described as the only metal available to the craftspeople building the Great Pyramid. Consequently, it would follow that all work must have sprung from their use of this basic metallic element. Theorists may be entirely wrong, however, even in their basic assumption that copper was the only metal available to the ancient Egyptians.

Another little known fact about the pyramid builders is that they were iron makers as well. You will not find much reference to this fact in textbooks; as researchers have only found one piece of wrought iron, and because of its singularity, Egyptologists have not attached much significance to it. Howard-Vyse's assistant, J. R. Hill, discovered this wrought iron within one of the joints of the Great Pyramid's limestone masonry in 1837 (see Appendix B). From there it was delivered to the British Museum. As it was the only piece of iron ever found from that era, its impact was not significant enough to change our concept of world history. However, it is important to note that if there was an abundance of iron or steel at the time of the Great Pyramid's building, its survival would be dependent on some kind of sanctuary from the elements, such as being buried in the limestone of the pyramid. Recent analysis of this metal discovered that it had traces of gold on one surface, as though it had been gold plated at one time.

Because of the convincing documentation of the discovery of wrought iron

at the Great Pyramid and the identification of the builders of the Great Pyramid as the makers of that iron, we are left to ponder the possibility that other ferrous materials existed in prehistory. It is fair of us to ask, therefore, what other kinds of metal components—without the protection of several feet of limestone—would have rusted or have been sand-blasted away during the passage of thousands of years? Without going back in time and interviewing the craftspeople who worked on the pyramids, we will never know for sure what materials their tools were made of. Any debate of the subject would be futile, for until the proof is at hand, we can reach no satisfactory conclusion. However, we can surmise the manner in which the masons used their tools, and if we compare current methods of cutting granite with the finished product (i.e., the granite coffer), we can find a solid base on which to draw several enlightening parallels.

So let us do just that. Today's granite-cutting methods include the use of wire saws and an abrasive, usually silicon-carbide, which has a hardness comparable with diamond and, therefore, is hard enough to cut through the quartz crystal in the granite. The wire is a continuous loop that is held by two wheels, one of the wheels being the driver. Between the wheels, which can vary in distance depending on the size of the machine, the granite is cut by being pushed against the wire or by being held firmly and allowing the wire to feed through it. The wire does not actually cut the granite, but is designed to effectively hold the silicon-carbide grit that in fact does the cutting. By looking at the shapes of the cuts that were made in the basalt items 3b and 5b, as shown in Figure 17, one could certainly speculate that a wire saw had been used and left its imprint in the rock. The full radius at the bottom of the cut is exactly the shape that would be left by such a saw.

Wanting to know more about the sawing of granite, I consulted John Barta, of the John Barta Company, who informed me that the wire saws used in quarry mills today cut through granite with great rapidity. In fact, Barta told me that wire saws with silicon-carbide cut through the granite like it is butter. Out of interest, I asked Barta what he thought of the copper chisel theory proposed by Egyptologists. Suffice it to say that Barta, being from Cleveland, and possessing an excellent sense of humor, came forth with some jocular remarks regarding the practicality of such an idea.

If the ancient Egyptians had indeed used wire saws for cutting hard rock,

our next question would be to ask if these saws were powered by hand or machine. With my experience in machine shops and the countless number of times I have had to use saws (both handsaws and power saws), I was able to recognize strong evidence that, in at least some instances, the latter method was used.

Once again, Petrie provided us with a clue: "On the N. end [of the coffer] is a place, near the west side, where the saw was run too deep into the granite, and was backed out again by the masons; but this fresh start they made still too deep, and two inches lower they backed out a second time, having cut out more than .10 inch deeper than they had intended. . . . "[2]

The above was Petrie's notes on the coffer inside the King's Chamber in the Great Pyramid. The following concerned the coffer inside the Second Pyramid: "The coffer is well polished, not only inside but all over the outside; even though it was nearly all bedded into the floor, with the blocks plastered against it. The bottom is left rough, and shows that it was sawn and afterwards dressed down to the intended height; but in sawing it the saw was run too deep and then backed out; it was, therefore, not dressed down all over the bottom, the worst part of the sawing being cut .20 inch deeper than the dressed part. This is the only error of workmanship in the whole of it; it is polished allover the sides in and out, and is not left with the saw lines visible on it like the Great Pyramid coffer."[3]

Petrie estimated that a pressure of one to two tons on jeweled-tipped bronze saws would have been necessary to cut through the extremely hard granite. If we agree with those estimates as well as with the methods proposed by Egyptologists regarding the construction of the pyramids, then a severe inequity can be discerned between the two theories.

So far, Egyptologists have not given credence to any speculation that suggests that the builders of the pyramid might have used machines instead of manpower in this massive construction project. In fact, they do not give the pyramid builders the intelligence to have developed and used the simple wheel. It is quite remarkable that a culture that possessed sufficient technical ability to make a lathe and progressed from there to develop a technique that enabled them to machine radii in hard diorite would not have thought of the wheel before then.

Petrie logically assumed that the granite coffers found in the Giza pyramids were marked prior to being cut. The workers were given a guideline with which to work. The accuracy exhibited in the dimensions of the coffers confirms this, plus the fact that guidelines of some sort would have been necessary to alert the masons of their error.

While no one can say with certainty how the granite coffers were cut, the saw marks in the granite have certain characteristics which suggest that they were not the result of hand sawing. If there was not evidence to the contrary, I might agree that the manufacturing of the granite coffers in the Great Pyramid and the Second Pyramid could quite possibly have been achieved using pure manpower-and a tremendous amount of time. But it is extremely unlikely that a team of masons operating a nine—foot handsaw would be cutting through hard granite fast enough that they would pass their guideline before noticing the error. To then back the saw out and repeat the same error, as they did on the coffer in the King's Chamber, does nothing to confirm the speculation that this object was the result of handwork.

When I read Petrie's passage concerning these deviations, a flood of memories came to me of my own history with saws, both power and manual driven. My experience, plus my observations of others using power saws, makes it inconceivable to me that manpower drove the saw that cut the granite coffers. While cutting steel with handsaws, workers would be able to see the direction the saw blade would make well in advance of making a serious mistake, especially in an object that has a long workface and, certainly, in one with such dimensions as the coffers, which could not be cut with great rapidity. The smaller the workpiece, naturally, the faster the blade would cut through it. On the other hand, if the saw was mechanized and was cutting rapidly through the workpiece, the saw could "wander" from its intended course and cut through the guideline at a certain point at such a speed that the error could be made before the condition could be corrected. This is not uncommon. I do not mean to imply that a manually operated saw cannot wander, only that the speed of the operation would determine the efficiency in discovering any deviation that the saw might have from its intended course.

Another interesting point to consider in Petrie's observations of the coffer was that the saw was run too deeply, backed out, and then cut into the stone

again. Anyone who has been faced with the problem of drawing a saw blade out of a cut and then making a restart on only one side of the cut, which is essentially what was done with the granite, knows that excessive pressure on the blade would force it back into the original cut. To make a restart of this type, it is necessary that very little pressure be put on the blade. With these considerations, it is doubtful if we can ever verify Petrie's deductions that two or three tons of pressure were necessary to cut the granite.

Making a restart in the middle of a cut, especially one of such dimensions as the granite coffer, would be more easily accomplished with machine sawing than it would be with hand sawing. With hand sawing there is little control over the blade in a situation like this, and it would be difficult to accurately gauge the amount of pressure needed. Also, the blade of the handsaw would be moving quite slowly, a fact that causes me to question further the suggestion that a handsaw was being used. I believe, based on my own and others' experiences, that the accomplishment of such a feat, using a saw at such a slow speed and with very little pressure, would be almost, if not completely, impossible.

With a power-driven saw, on the other hand, the blade moves rapidly and can be more easily controlled. The blade can be held in a fixed position, with uniform pressure over the entire length of the blade, and in the direction necessary to restart a cut. A worker can accurately maintain this front and side pressure until sufficient material has been removed from the workpiece to allow a continuation of normal cutting speed. The evidence from the Great Pyramid's granite coffer shows that workers attained a normal cutting rate shortly after they rectified the mistake, a fact that can be deduced by noting that the mistake was repeated two inches further along. At that point the blade was cutting through the granite at the wrong place faster than the workers were able to detect and stop it.

Another method of correcting a mistake while using a handsaw, if the error was only in a small area of the cut, would be to tilt the blade and continue cutting in the unspoiled area, so that when the blade reached the area that needed correcting, it would be supported by the fresh tilted cut and would have sufficient strength to combat any tendencies to follow the original straight cut. If the granite coffer had been cut with handsaws, it is conceivable that the workers could have used this method to correct their

cutting errors. However, it has probably become apparent by now that Petrie had the eye of a hawk and documented just about everything he saw. At the same time he was studying the cutting mistakes in the granite, he also noticed other features of these artifacts: "[The coffer in the King's Chamber] is not finely wrought, and cannot in this respect rival the coffer in the Second Pyramid. On the outer sides the lines of sawing may be plainly seen: horizontal on the N., a small patch horizontal on the E., vertical on the S., and nearly horizontal on the W.; showing that the masons did not hesitate at cutting a slice of granite 90 inches long, and that the jeweled bronze saw must have been probably about 9 feet long."[4]

If the operators of the saw, in an attempt to correct a mistake, had tilted their blade in the manner described above, the saw lines would show a difference from the pre-error saw lines because they would be at an angle. The mistakes in the granite were found on the north side of the coffer, and Petrie observed that the saw lines on that side were horizontal. Following Petrie's footsteps, in 1986 I was able to verify his observations of the coffer in the Great Pyramid. The saw lines on the side where the mistakes were made are all horizontal, invalidating any argument proposing that the mistake was overcome by tilting the blade, which is probably the only method that would be successful using a handsaw. This evidence points to the distinct probability that the pyramid builders possessed motorized machinery when they cut the granite found inside the Great Pyramid and the Second Pyramid.

Today these saw marks would reflect either the differences in the aggregate dimensions of a wire bandsaw with the abrasive, or the side-to-side movement of the wire, or the wheels that drive the wire. The result of any of these conditions is a series of slight grooves. The feedrate and either the distance between the variation in length of the saw or the diameter of the wheels determine the distance between the grooves. The distance between the grooves on the coffer inside the King's Chamber is approximately .050 inch.

Along with the evidence on the outside of the King's Chamber coffer, we find further evidence of the use of high-speed machine tools on the inside of the granite coffer. The methods that were evidently used by the pyramid builders to hollow out the inside of the granite coffers are similar to the methods that would be used to machine out the inside of components today. Tool marks on the coffer's inside indicate that when the granite was hollowed

out, workers made preliminary roughing cuts by drilling holes into the granite around the area that was to be removed (see Figure 18). According to Petrie, those drill holes were made with tube-drills, which left a central core that had to be knocked away after the hole had been cut. After all the holes had been drilled and all the cores removed, Petrie surmised that the coffer was then handworked to its desired dimension. The machinists on that particular piece of granite once again let their tools get the better of them, and the resulting errors are still to be found on the inside of the coffer. As Petrie noted, "On the E. inside is a portion of a tube-drill hole remaining, where they had tilted the drill over into the side by not working it vertically. They tried hard to polish away all that part, and took off about 1/10 inch thickness all around it ; but still they had to leave the side of the hole 1/10 deep, 3 long, and 1.3 wide; the bottom of it is 8 or 9 below the original top of the coffer. They made a similar error on the N. inside, but of a much less extent. There are traces of horizontal grinding lines on the W. inside."[5]

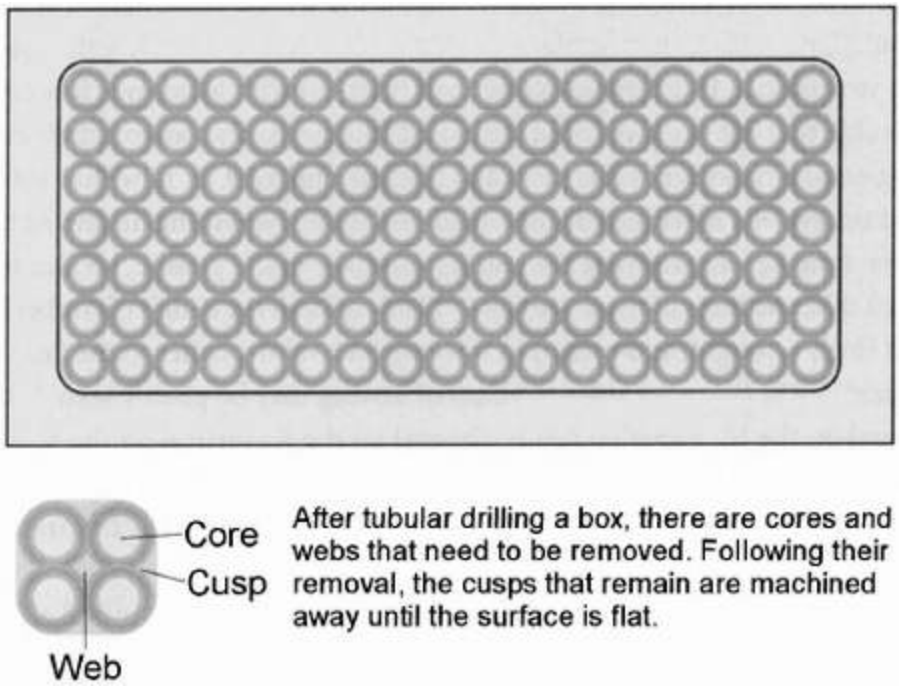

Core
Cusp
Web
After tubular drilling a box, there are cores and webs that need to be removed. Following their removal, the cusps that remain are machined away until the surface is flat.

FIGURE 18. ***Tube-drilling a Granite Box***

The errors Petrie noted are not uncommon in modern machine shops, and I must confess to having made them myself on occasion. Several factors could be involved in creating this condition, although I cannot visualize any one of

them being a hand operation. Once again, while working their drill into the granite, the machinists had made a mistake before they had time to correct it.

Let us speculate for a moment that the drill was being worked by hand. How far into the granite would the Egyptian craftspeople have been able to cut before the drill had to be removed to permit cleaning the waste out of the hole? Would they be able to drill eight or nine inches into the granite without having to remove their drill? It is inconceivable to me that they could have achieved such a depth with a hand-operated drill without the frequent withdrawal of the drill to clean out the hole or without their making provisions for the removal of the waste while the drill was still cutting. By frequently withdrawing the drill, however, they would have been able to expose their error and notice the direction their drill was taking before it had cut a .200-inchgouge into the side of the coffer and before it had reached a depth of eight or nine inches. The same situation applies as easily with the drill as with the saw—a high-speed operation made an error before the operators had time to correct it.

Although the ancient Egyptians are not given credit for having the wheel, the fact is that archaeological evidence, when evaluated with a machinist's eye, proves that they not only had the wheel, but they used it in very sophisticated ways. The evidence of lathe work is markedly distinct on some of the artifacts housed in the Cairo Museum, as well as those that were studied by Petrie. And if the Egyptians indeed used a lathe, then they had developed the wheel, for the products turned on a lathe, being circular, have the elements of being wheels—in fact, the wheels that are used on locomotives are turned on lathes. So although the lathes used by the ancient Eygptians have long disappeared, Petrie was very clear that they had existed when he identified the marks of true lathe turning on two pieces of diorite in his collection. It is true that intricate objects can be created without the aid of machinery simply by rubbing the material with an abrasive such as sand or using a piece of bone or wood to apply pressure. The relics Petrie was looking at, however, in his words, "could not be produced by any grinding or rubbing process which pressed on the surface."[6]

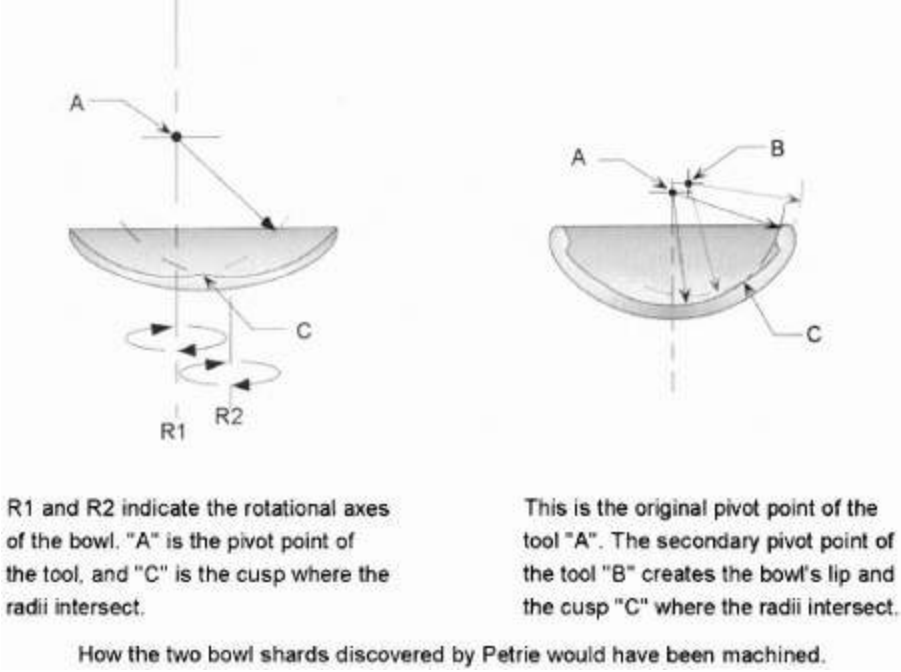

A
C
R1
R2
A
B
C
R1 and R2 indicate the rotational axes of the bowl. "A" is the pivot point of the tool, and "C" is the cusp where the radii intersect.
This is the original pivot point of the tool "A". The secondary pivot point of the tool "B" creates the bowl's lip and the cusp "C" where the radii intersect.
How the two bowl shards discovered by Petrie would have been machined.

FIGURE 19. ***Petrie's Bowl Shards***

The simple rock bowl shards Petrie was studying would hardly be considered remarkable to the inexperienced eye. However, Petrie, devoting as much care to the observation of this artifact (a) as he did to others, found that the spherical concave radius forming the dish had an unusual feel to it. Upon closer examination, he detected a sharp cusp where two radii intersected, indicating that the radii were cut on two separate axes of rotation (see Figure 19).

I have witnessed the same condition when a component has been removed from a lathe and then worked on again without being recentered properly. On examining other pieces from Giza, Petrie found another bowl shard that had the marks of true lathe turning (b). This time, though, instead of shifting the workpiece's axis of rotation, a second radius was cut by shifting the pivot point of the tool. With this radius, they machined just short of the perimeter of the dish, leaving a small lip. Again, a sharp cusp defined the intersection of the two radii.

While browsing through the Cairo Museum, I found evidence of lathe turning on a large scale. A sarcophagus lid had distinct lathe turning marks. The radius of the lid terminated with a blend radius at shoulders on both ends. The tool marks near these corner radii were the same as those I have observed

when turning an object with an intermittent cut. The tool is deflected under pressure from the cut, and then relaxes when the section of cut is finished. When the workpiece comes round again to the tool, the initial pressure causes the tool to dig in. As the cut progresses, the amount of "dig in" is diminished. On the sarcophagus lid in the Cairo Museum, tool marks indicating these conditions were exactly where one would expect to find them (see Figure 20).

Egyptian artifacts representing tubular drilling are clearly the most astounding and conclusive evidence yet presented to indicate the extent to which machining knowledge and technology were practiced in prehistory. The ancient pyramid builders used a technique for drilling holes that is commonly known as "trepanning." This technique leaves a central core and is an efficient means of hole making. When making holes that did not go all the way through the material, the workers drilled to the desired depth and then broke the core out of the hole. Trepanning was evident not only in the holes that Petrie studied, but on the cores cast aside by the masons who had done the work. Regarding tool marks that left a spiral groove on a core taken out of a hole drilled into a piece of granite, Petrie wrote, "On the granite core, No.7, the spiral of the cut sinks .1 inch in the circumference of 6 inches, or 1 in 60, a rate of ploughing out of the quartz and feldspar which is astonishing."[7] After reading this, I had to agree with Petrie. This was an incredible feedrate (distance traveled per revolution of the drill) for drilling into any material, let alone granite. I was completely confounded as to how a drill could achieve this feedrate. Petrie was so astounded by these artifacts that he attempted to explain them at three different points in one chapter of his book.[8] To an engineer in the 1880s, what Petrie was looking at was an anomaly. The characteristics of the holes, the cores that came out of them, and the tool marks would be an impossibility according to any conventional theory of ancient Egyptian craftsmanship, even with the technology available in Petrie's day. Three distinct characteristics of the hole and core, as illustrated in Figure 21, make the artifacts extremely remarkable:

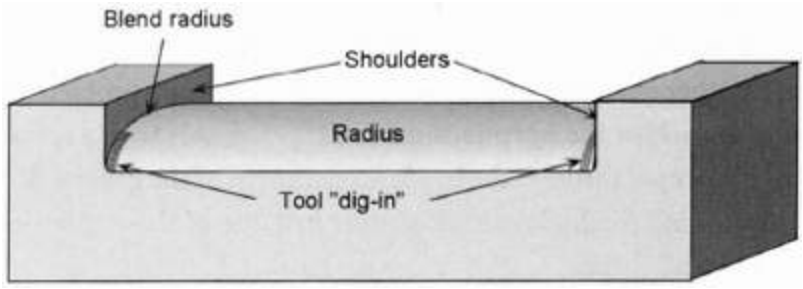


FIGURE 20. ***Sarcophagus Lid in the Cairo Museum***

- A taper on both the hole and the core.
- A symmetrical helical groove following these tapers showing that the drill advanced into the granite at a feedrate of .10 inch per revolution of the drill.
- The confounding fact that the spiral groove cut deeper through the quartz than through the softer feldspar.

In conventional machining the reverse would be the case. In 1983 Donald Rahn of Rahn Granite Surface Plate Co. told me that diamond drills, rotating at nine hundred revolutions per minute, penetrate granite at the rate of one inch in five minutes. In 1996, Eric Leither of Tru-Stone Corp. told me that these parameters have not changed since then. The feedrate of modern drills, therefore, calculates to be .0002 inch per revolution, indicating that the ancient Egyptians drilled into granite with a feedrate that was five hundred times greater or deeper per revolution of the drill than modern drills! The other characteristics of the artifacts also pose a problem for modern drills. Somehow the Egyptians made a tapered hole with a spiral groove that was cut deeper through the harder constituent of the granite. If conventional machining methods cannot answer just one of these questions, how do we answer all three?

For those who may still believe in the "official" chronology of the historical development of metals, identifying copper as the metal the ancient Egyptians used for cutting granite is like saying that aluminum could be cut using a chisel fashioned out of butter. What follows is a more feasible and logical method, and it provides an answer to the question of techniques the ancient Egyptians may have used in all aspects of their work.

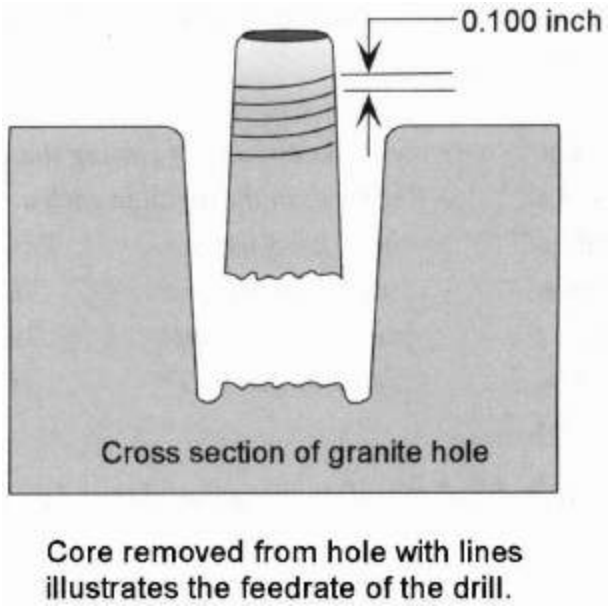


FIGURE 21. ***Petrie's Valley Temple Core & Hole***

The fact that the feedrate evenly spirals along the length of the granite cores is quite remarkable considering the proposed method of cutting. The taper indicates an increase in the cutting surface area of the drill as it cut deeper, hence an increase in the resistance. A uniform feed under those conditions, using manpower, would be impossible. Petrie's theory of a ton or two of pressure being applied to a tubular drill consisting of bronze inset with jewels does not take into consideration that under several thousand pounds of pressure the jewels would undoubtedly work their way into the softer substance (the bronze), leaving the granite relatively unscathed after the attack. Nor does this method explain the groove being deeper through the quartz.

It should be noted that Petrie did not identify the means by which he inspected the core, whether he used metrology instruments, a microscope, or the naked eye. It also should be noted that Egyptologists do not universally accept his conclusions. *In Ancient Egyptian Materials and Industries,* A. Lucas takes issue with Petrie's conclusion that the grooves were the result of fixed jewel points. He wrote:

> *In my opinion, to suppose the knowledge of cutting these gem stones to form teeth and of setting them in the metal in such a manner that they would bear the strain of hard use, and to do this at the early period*

assigned to them, would present greater difficulties than those explained by the assumption of their employment. But were there indeed teeth such as postulated by Petrie? The evidence to prove their presence is as follows.

(a) A cylindrical core of granite grooved round and round by a graving point, the grooves being continuous and forming a spiral, with in one part a single groove that may be traced five rotations round the core.

(b) Part of a drill hole in diorite with seventeen equidistant grooves due to the successive rotation of the same cutting point.

(c) Another piece of diorite with a series of grooves ploughed out to a depth of over one-hundredth of an inch at a single cut.

(d) Other pieces of diorite showing the regular equidistant grooves of a saw.

(e) Two pieces of diorite bowls with hieroglyphs incised with a very free-cutting point and neither scraped nor ground out.

But if an abrasive powder had been used with soft copper saws and drills, it is highly probable that pieces of the abrasive would have been forced into the metal, where they might have remained for some time, and any such accidental and temporary teeth would have produced the same effect as intentional and permanent ones. . . .[9]

Lucas went on to speculate that the workers withdrew the tube-drill in order to remove waste and insert fresh grit into the hole, thereby creating the grooves. However, there are problems with this theory. It is doubtful that a simple tool that is being turned by hand would remain turning while the artisans draw it out of the hole. Likewise, placing the tool back into a clean hole with fresh grit would not require that the tool rotate until it was at the workface. There also is the question of the taper on both the hole and the core. Both would effectively provide clearance between the tool and the granite, thereby making sufficient contact to create the grooves impossible under these conditions.

In contrast, ultrasonic drilling fully explains how the holes and cores found in the Valley Temple at Giza could have been cut, and it is capable of

creating all the details that Petrie and I puzzled over. Unfortunately for Petrie, ultrasonic drilling was unknown at the time he made his studies, so it is not surprising that he could not find satisfactory answers to his queries. In my opinion, the application of ultrasonic machining is the only method that completely satisfies logic, from a technical viewpoint, and explains all noted phenomena.

Ultrasonic machining is the oscillatory motion of a tool that chips away material, like a jackhammer chipping away at a piece of concrete pavement, except much faster and not as measurable in its reciprocation. The ultrasonic tool bit, vibrating at 19,000-to 25,000-cycles-per-second (hertz), has found unique application in the precision machining of odd-shaped holes in hard, brittle material such as hardened steels, carbides, ceramics, and semiconductors. An abrasive slurry or paste is used to accelerate the cutting action.[10]

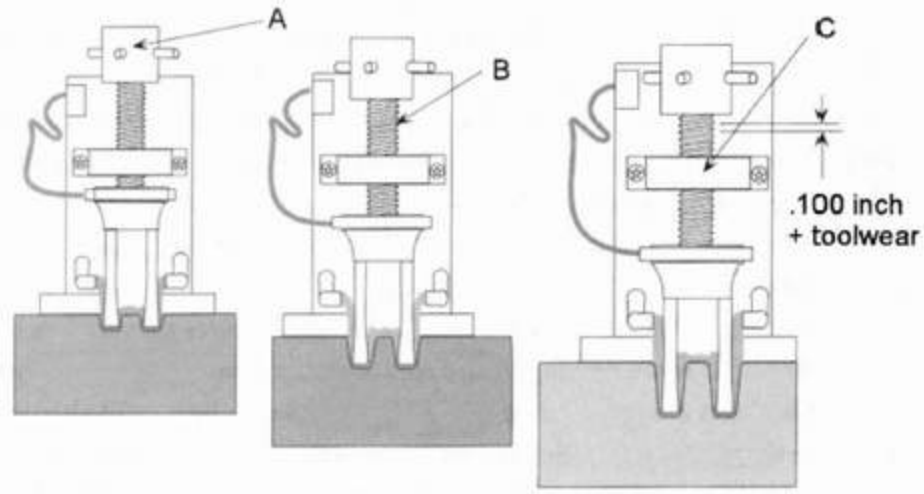
The most significant detail of the drilled holes and cores studied by Petrie was that the groove was cut deeper through the quartz than through the feldspar. Quartz crystals are employed in the production of ultrasonic sound and, conversely, are responsive to the influence of vibration in the ultrasonic ranges and can be induced to vibrate at high frequency. When machining granite using ultrasonics, the harder material (quartz) would not necessarily offer more resistance, as it would during conventional machining practices. An ultrasonically vibrating tool bit would find numerous sympathetic partners, while cutting through granite, embedded right in the granite itself. Instead of resisting the cutting action, the quartz would be induced to respond and vibrate in sympathy with the high-frequency waves and amplify the abrasive action as the tool cut through it.

The tapering sides of the hole and the core are perfectly normal when we consider the basic requirement for all types of cutting tools. This requirement is that clearance be provided between the tool's nonmachining surfaces and the workpiece. Instead of having a straight tube, therefore, we would have a tube with a wall thickness that gradually became thinner along its length. The outside diameter becomes gradually smaller, creating clearance between the tool and the hole, and the inside diameter becomes larger, creating clearance between the tool and the central core. This would allow a free flow of abrasive slurry to reach the cutting area. By using a tube-drill of this design,

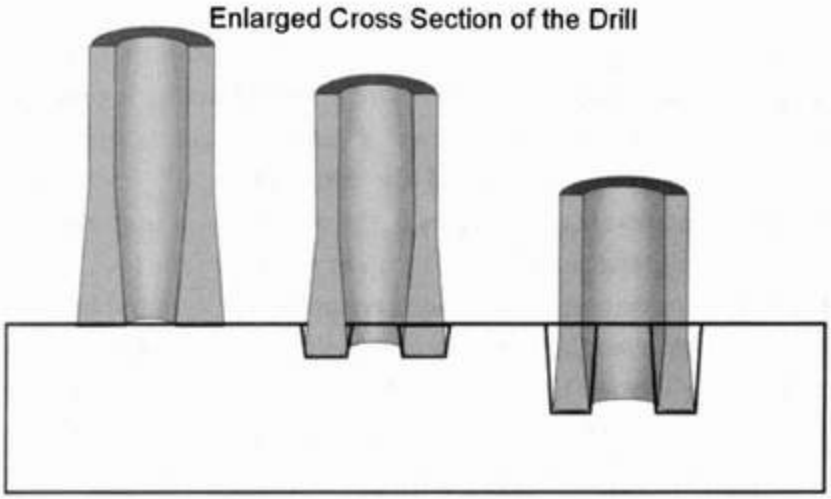
the tapering of the sides of the hole and the core is explained. Typically this type of tube-drill is made of softer material than the abrasive, and the cutting edge would gradually wear away. The dimensions of the hole, therefore, would correspond to the dimensions of the tool at the cutting edge. As the tool became worn, the hole and the core would reflect this wear in the form of a taper (see Figure 22).

The requirement for advancing an ultrasonic tool into a workpiece is for the cutting edge of the tool to apply pressure to the workpiece as the vibratory motion of the tool does the actual cutting. This can be accomplished two ways: The tool can plunge straight down, or it can be screwed into the workpiece. We can explain the spiral groove if we select the latter method as the most likely one used. It should be made clear that the rotational speed of the drill is not a major factor in this cutting method; it is merely a means to advance the drill and apply pressure to the workpiece. Using a screw-and-nut method, the tube-drill could be efficiently advanced into the workpiece by turning it in a clockwise direction (see Figure 22). The screw would gradually thread through the nut, forcing the oscillating drill into the granite. It would be the ultrasonically induced motion of the drill that would do the cutting, not the drill-bit's rotation. The latter would be needed only to sustain a cutting action at the workface. By definition, the process is not a drilling process by conventional standards, but a grinding process in which abrasives are caused to impact the material in such a way that a controlled amount of material is removed.

The fact that there is a groove at all in the Valley Temple core may be explained several ways. An uneven flow of energy may have caused the tool to oscillate more on one side than the other, the tool may have been improperly mounted, or a buildup of abrasive on one side of the tool may have cut the groove as the tool spiraled into the granite.



Shows the progression of drilling in granite using ultrasonic (vibratory) drill. The drill advances .100 inch plus toolwear for every rotation of the handle (A).



The abrasive slurry wears the tool as well as the granite. The tool length diminishes as the cut deepens, resulting in a taper on the core and the hole.

FIGURE 22. ***Ultrasonic Drilling of Granite***

Another method by which the grooves could have been created was through the use of a spinning trepanning tool that had been mounted off-center to its rotational axis. Clyde Treadwell of Sonic Mill Inc. explained to me that when an off-centered drill rotated into the granite, it would gradually be forced into alignment with the rotational axis of the drilling machine's axis. The grooves, he claimed, could be created as the drill was rapidly withdrawn from the hole.

If Treadwell's theory is the correct one, it still requires a level of technology that is far more developed and sophisticated than what the ancient pyramid builders are given credit for. This method may be a valid alternative to the theory of ultrasonic machining, even though ultrasonics resolves all the unanswered questions where other theories have fallen short. When we search for a single method that provides an answer for all the data, we find that neither primitive nor most conventional machining methods provide that answer; consequently, we are forced to consider methods that are cutting-edge technologies even in our own time.

It goes without saying that further studies need to be made. One way to decide between opposing theories is to replicate the cores using the advanced machining methods I propose and the more primitive methods proposed by some Egyptologists. Following such a replication, the cores can be compared using metrology equipment and a scanning electron microscope in order to detect the microscopic changes in the structure of the granite that can result from the pressure and heat exerted or created by the tool. I doubt many Egyptologists share my conclusions regarding the pyramid builders' drilling methods, so it would be beneficial to perform these tests in order to prove conclusively the most likely method the builders used for cutting stone.

As this book was being prepared for publication, I received an unexpected e-mail from *NOVA*'s stonemason, Roger Hopkins, who had read my article about ancient Egyptian technology on the Internet. He wrote:

Dear Chris,

You are a voice in the wilderness. I just finished reading your article about stone working techniques in ancient Egypt. I am a stonemason by trade and in 1991 the PBS series NOVA invited me to go to Egypt to experiment with building a pyramid; I quickly got bored with working the soft limestone and started to ponder the granite work. Here in Massachusetts, my specialty is working in granite (see my web page: http://tiac.net/users/rhopkins).

When I was asked by the Egyptologists how the ancients could have produced this work with mere copper tools, I told them they were crazy and that they were using at least state-of-art techniques. [At] first glance I tend to agree with you about the ultrasonic core hole drilling. I do

enough core hole drilling to know that the embedded scrape marks would not be the result of ordinary core drilling. . . . I would love to explore this technique further with you and perhaps do a presentation in our next film about Egypt. . . .

Sincerely,
Roger Hopkins

In my subsequent communications with Hopkins, I found him to be very honest and straightforward regarding the techniques used by the ancients. His account of the building of the *NOVA* pyramid was much the same as that reported by Mark Lehner. He asked my permission to pursue the ultrasonic drilling aspects, as it was my idea, and I told him the more the merrier. The more people who are looking into how the ancient Egyptians accomplished their prodigious feats the better chance we have of determining the truth. Moreover, like any good businessman, Hopkins sees the potential for applying this technology in his own work.

My last e-mail from Hopkins informed me that he had contacted people at the Massachusetts Institute of Technology about pursuing this theory, had received promising feedback, and he would keep me informed. So the chapter on the ultrasonic drilling of Egyptian granite is at an end, even as this theory faces a new beginning.

Chapter Five

AMAZING DISCOVERY AT GIZA

In February 1995, *I joined Graham Hancock and Robert Bauval* in Cairo to participate in a documentary. While there, I came across and measured some artifacts produced by the ancient pyramid builders that prove beyond a shadow of a doubt that highly advanced and sophisticated tools and methods were employed by this ancient civilization. Two of the artifacts in question are well-known; another is not, but it is more accessible, since it is lying out in the open, partly buried in the sand of the Giza Plateau. For this trip to Egypt I had taken along some instruments with which I had planned to inspect features I had identified during my 1986 trip. The instruments were:

- *A "parallel"—a* flat ground piece of steel about six-inches long and one-quarter-inch thick. The edges are ground flat within .0002 inch.
- *An Interapid indicator* (known as a clock gauge by my British compatriots).
- *A wire contour gauge—a* device once used, before the advent of computer numerical controlled machining, by die-makers to form around shapes.
- *Hard forming wax.*

I had taken along the contour gauge to check the inside of the mouth of the Southern Shaft inside the King's Chamber, for reasons to be discussed in a forthcoming chapter. Unfortunately, I found out after getting there that things had changed since my last visit. In 1993, a fan was installed inside this opening and, therefore, it was inaccessible to me and I was unable to check it. I had taken the parallel for quick checking of the surface of granite artifacts to determine their precision. The indicator was to be attached to the parallel for

further inspection of suitable artifacts. Though the indicator did not survive the rigors of international travel, the instruments with which I was left were adequate for me to form a conclusion about the precision to which the ancient Egyptians were working.

Finding the King's Chamber in the Great Pyramid crowded with tourists, and not having the access I wanted to the Southern Shaft, I headed over to the Second Pyramid to inspect the "sarcophagus" there. Petrie had remarked that this granite box, like the one inside the King's Chamber, would had to have been installed in the bedrock chamber from above, before the chamber was roofed over and the pyramid finished, as it was too large to fit through the entrance passage. He supported his conclusion by pointing out that the bedrock chamber had gabled limestone beams that were put in place after the box was installed. Petrie's measurements of the passage were 41.08 to 41.62 inches wide by 47.13 to 47.44 inches high, and his dimensions of the box were 103.68 inches outside length, 41.97 inches outside width, 38.12 inches outside height; 84.73 inches inside length, 26.69 inches inside width, and 29.59 inches inside depth.[1] I.E.S. Edwards gave the angle of the entrance passage as 25°55'.depth.[2] Petrie may have been correct in his assumptions, depending on how the smaller sloping passage is vertically oriented with the larger horizontal passage. Petrie was comparing the width of the box to the width of the passage, and obviously it will not fit. However, the box *will* fit into the smaller entrance passage if it is turned on its side. The only question not answered is whether there is enough room for it to tilt where the sloping passage meets the horizontal passage. It is unfortunate these questions were not on my mind at the time I was inside the pyramid, but my mission, at that time, involved other aspects of the ancient pyramid builders' work.

Crouching through the entrance passage and into the bedrock chamber, I climbed inside the box and—with a flashlight and the parallel—was astounded to find the surface on the inside of the box perfectly smooth and perfectly flat. Placing the edge of the parallel against the surface I shone my flashlight behind it. No light came through the interface. No matter where I moved the parallel—vertically, horizontally, sliding it along as one would a gauge on a precision surface plate—I could not detect any deviation from a perfectly flat surface.

A group of Spanish tourists found my activity extremely interesting, and they gathered around me as I animatedly demonstrated my discovery while exclaiming into my tape recorder, "Space-age precision!" The tour guides were becoming quite animated, too. I sensed that they probably did not think it was appropriate for a live foreigner to be where they believed a dead Egyptian should go, so I respectfully removed myself from the sarcophagus and continued my examination visually from the outside of the box.

There were more features of this artifact that I wanted to inspect, of course, but I did not have the freedom to do so. The corner radii on the inside appeared to be uniform all around, with no variation of precision of the surface to the tangency point. I was tempted to take a wax impression, but the hovering guides expecting bribes (baksheesh) inhibited this activity. (I was on a very tight budget.)

My mind was racing as I lowered myself into the narrow confines of the entrance shaft and climbed to the outside of the pyramid. The inside of a huge granite box had been finished off to an accuracy that modern manufacturers reserve for precision surface plates. How did the ancient Egyptians achieve this? And why did they do it? Why did they find that box so important that they would go to such trouble? It would be impossible to do that kind of work on the inside of an object by hand. Even with modern machinery it would be a very difficult and complicated task! Another point to consider was that the box, and the one in the King's Chamber inside the Great Pyramid, did not have to be made out of one piece if the only purpose it served was to house a dead body. There is evidence in the Cairo Museum proving that the ancient Egyptians also constructed sarcophagi out of five pieces and a lid. So why did they find it necessary to create each of these two boxes out of single blocks, which required the extra planning and effort to lower them into their chambers rather than drag them through the passages?

Petrie stated that the mean variation of the dimensions of the box in the Second Pyramid was .04 inch. Not knowing where the variation he measured was, I am not going to make any strong assertions except to say that it is possible to have an object with geometry that varies in length, width, and height and still maintain perfectly flat surfaces. Surface plates are ground and lapped to within .0001 to .0003 inch, depending on the grade of the specific surface plate; however, the thickness may vary more than the .04 inch that

Petrie noted on that sarcophagus. A surface plate, though, is a single surface and would represent only one outside surface of a box. Moreover, the equipment used to rough and finish the inside of a box would be vastly different than that used on the outside. It would be much more problematic to grind and lap the inside of a box to the accuracy I had observed which would result in a precise and flat surface to the point where the flat surface meets the corner radius. The physical and technical problems associated with such a task are not easy to solve. One could use drills to rough the inside out, but when it comes to finishing a box of this size with an inside depth of 29.59 inches, while maintaining a corner radius of less than one-half inch, one would have to overcome some significant challenges.

While being extremely impressed with this artifact, I was even more impressed with other artifacts found at another site in the rock tunnels at the temple of Serapeum at Saqqara, the site of the Step Pyramid and Zoser's Tomb. I had followed Hancock and Bauval on their trip to this site for a filming on February 24, 1995. We were in the stifling atmosphere of the tunnels, where the dust kicked up by tourists lay heavily in the still air. These tunnels contain twenty-one huge granite and basalt boxes. Each box weighs an estimated sixty-five tons, and, together with the huge lid that sits on top of it, the total weight of each assembly is around one hundred tons. Just inside the entrance of the tunnels was an unfinished lid, and beyond this lid, barely fitting within the confines of one of the tunnels, was a granite box that also had been rough hewn.

The granite boxes were approximately 13-feet long, 7-1/2-feet wide, and 11-feet high. They were installed in "crypts" that were cut out of the limestone bedrock at staggered intervals along the tunnels. The floors of the crypts were about four feet below the tunnel floor, and the boxes were set into recesses in the center. Bauval had commented earlier about the engineering aspects of installing such huge boxes within a confined space where the last crypt was located near the end of the tunnel. With no room for the hundreds of slaves pulling on ropes to position these boxes, how were they moved into place?

While Hancock and Bauval were filming, I jumped down into a crypt and placed my parallel against the outside surface of the box. It was perfectly flat. I shone the flashlight and found no deviation from a perfectly flat surface. I

clambered through a broken-out edge into the inside of another giant box and, again, I was astonished to find it astoundingly flat. I looked for errors and could not find any. I wished at that time that I had the proper equipment to scan the entire surface and ascertain the full scope of the work. Nonetheless, I was perfectly happy to use my flashlight and straightedge and stand in awe of this incredibly precise and incredibly huge artifact. Checking the lid and the surface on which it sat, I found them both to be perfectly flat. It occurred to me that this gave the manufacturers of this piece a perfect seal—two perfectly flat surfaces pressed together, with the weight of one pushing out the air between the two surfaces. The technical difficulties in finishing the inside of that piece made the sarcophagus in Khafra's Pyramid seem simple in comparison. Canadian researcher Robert McKenty was accompanying me at this time. He saw the significance of the discovery and was filming with his camera. At that moment I knew how Howard Carter must have felt when he discovered Tutankhamen's tomb.

The dust-filled atmosphere in the tunnels made breathing uncomfortable. I could only imagine what it would be like if I were a craftsman finishing off a piece of granite in that tunnel; regardless of the method I used, it would be unhealthy work. Surely it would have been better to finish the work in the open air? I was so astonished by this find that it did not occur to me until later that the builders of these relics, for some esoteric reason, intended for them to be ultra precise. They had gone to the trouble to take the unfinished product into the tunnel and finish it underground for a good reason. It is the logical thing to do if you require a high degree of precision in the piece that you are working. To finish it with such precision at a site that maintained a different atmosphere and a different temperature, such as in the open under the hot sun, would mean that when it was finally installed in the cool, cavelike temperatures of the tunnel, the workpiece would lose precision. The granite would give up its heat, and in doing so change its shape through contraction. The solution then as now, of course, was to prepare precision objects in a location that had the same heat and humidity in which they were going to be housed.

This discovery, and the realization of its critical importance to the artisans that built it, went beyond my wildest dreams of discoveries to be made in Egypt. For a man of my inclination, this was better than King Tut's tomb. The

Egyptians' intentions with respect to precision are perfectly clear, but to what end? Further studies of these artifacts should include thorough mapping and inspection with the following tools:

- *A laser for checking surface flatness*—typically used for aligning precision machine beds.
- *An ultrasonic thickness gauge*—to check the thickness of the walls to determine their consistency to uniform thickness.
- *An optical flat with monochromatic light source*—to determine if the surfaces really are finished to optical precision.

I have contacted four precision granite manufacturers in the United States and not one can do this kind of work. In correspondence with Eric Leither of Tru-Stone Corp., I discussed the technical feasibility of creating several Egyptian artifacts, including the giant granite boxes found in the bedrock tunnels at the temple of Serapeum at Saqqara (see Figure 23). He responded as follows:

Dear Christopher,

First I would like to thank you for providing me with all the fascinating information. Most people never get the opportunity to take part in something like this. You mentioned to me that the box was derived from one solid block of granite. A piece of granite of that size is estimated to weigh 200,000pounds if it was Sierra White granite which weighs approximately 175 lb. per cubic foot. If a piece of that size was available, the cost would be enormous. Just the raw piece of rock would cost somewhere in the area of $115,000.00. This price does not include cutting the block to size or any freight charges. The next obvious problem would be the transportation. There would be many special permits issued by the D.O.T. and would cost thousands of dollars. From the information that I gathered from your fax, the Egyptians moved this piece of granite nearly 500 miles. That is an incredible achievement for a society that existed hundreds of years ago.

Eric went on to say that his company did not have the equipment or

capabilities to produce the boxes in this manner. He said that they would create the boxes in five pieces, ship them to the customer, and bolt them together on site.

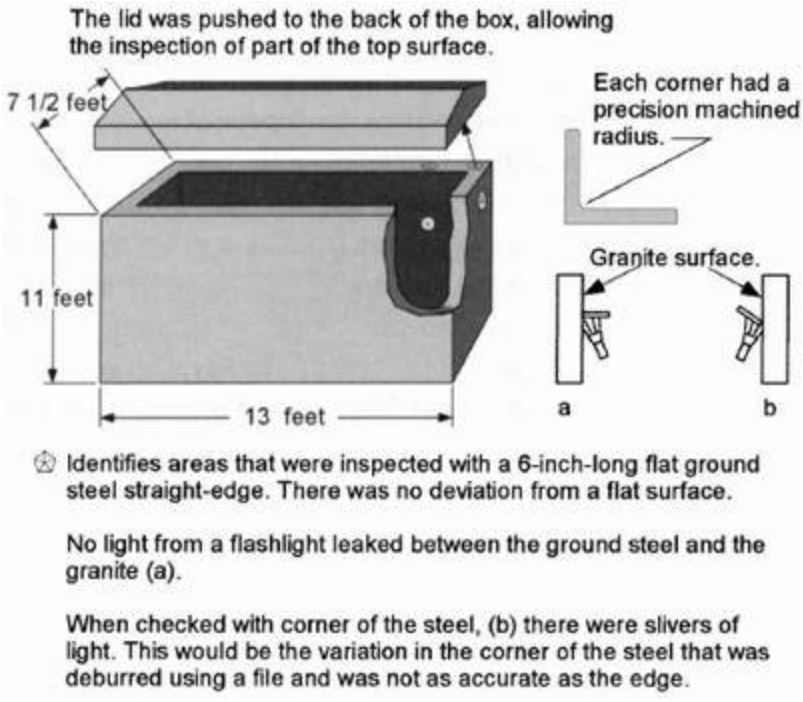

The lid was pushed to the back of the box, allowing the inspection of part of the top surface.
7 1/2 feet
11 feet
13 feet
Each corner had a precision machined radius.
Granite surface.
a
b
Identifies areas that were inspected with a 6-inch-long flat ground steel straight-edge. There was no deviation from a flat surface.
No light from a flashlight leaked between the ground steel and the granite (a).
When checked with corner of the steel, (b) there were slivers of light. This would be the variation in the corner of the steel that was deburred using a file and was not as accurate as the edge.

FIGURE 23. ***Granite Box in the Rock Tunnels at Saqqara***

Another artifact I inspected was a piece of granite that I, quite literally, stumbled across while strolling around the Giza Plateau later that day. I concluded, after doing a preliminary check of this piece, that the ancient pyramid builders had to have used a machine with three axes of movement (X-Y-Z) to guide the tool in three-dimensional space to create it. This artifact is very precise, even though it is a complex, contoured shape. Flat surfaces, having a simple geometry, can justifiably be explained as having been created by simple methods. This piece, though, because of its shape, drives us beyond the question, "What tools were used to cut it?" to a more far-reaching question, "What guided the cutting tool?" To properly address this question and be comfortable with the answer, it is helpful for us to have a working knowledge of contour machining.

Many of the artifacts that modern civilization creates would be impossible to produce using simple handwork. We are surrounded by artifacts that are the result of men and women employing their minds to create tools that

overcome physical limitations. We have developed machine tools to create the dies that produce the aesthetic contours on the cars that we drive, the radios we listen to, and the appliances we use. To create the dies to produce these items, a cutting tool has to accurately follow a predetermined contoured path in three dimensions. The development of computer software has allowed some applications to move in three dimensions, while simultaneously using three or more axes of movement. The Egyptian artifact that I was looking at required a minimum of three axes of motion to machine it. When the machine-tool industry was relatively young, techniques were employed where the final shape was finished by hand, using templates as a guide. Today, with the use of precision computer numerical control machines, there is little call for handwork. A little polishing to remove unwanted tool marks may be the only handwork required. To know that an artifact has been produced on such a machine, therefore, one would expect to see a precise surface with indications of tool marks that show the path of the tool. This is what I found on the Giza Plateau, lying out in the open south of the Great Pyramid about one hundred yards east of Khafre's Pyramid (see Figure 24).

There are so many rocks of all shapes and sizes lying around this area that to the untrained eye these could easily be overlooked. To a trained eye, they may attract some cursory attention and a brief muse. I was fortunate that they both caught my attention and that I had some tools with which to inspect them. There were two pieces lying close together, one larger than the other. They had originally been one piece and had been broken. I found I needed every tool I had brought with me to inspect it. I was most interested in the accuracy of the contour and its symmetry.

What we have is an object that, three dimensionally as one piece, could be compared in shape to a small sofa. The seat is a contour that blends into the walls of the arms and the back. I checked the contour using the profile gauge along three axes of its length, starting at the blend radius near the back and ending near the tangency point, which blended smoothly where the contour radius meets the front. The wire radius gauge was not the best way to determine the accuracy of this piece. When adjusting the wires at one position on the block and moving to another position, the gauge could be reseated on the contour, but questions could be raised as to whether the hand that positioned it compensated for some inaccuracy in the contour. However,

placing the parallel at several axial positions on the contour, I found the surface of this artifact to be extremely precise. At one point near a crack in the piece, there was light showing through, but the rest of the piece allowed very little to show.

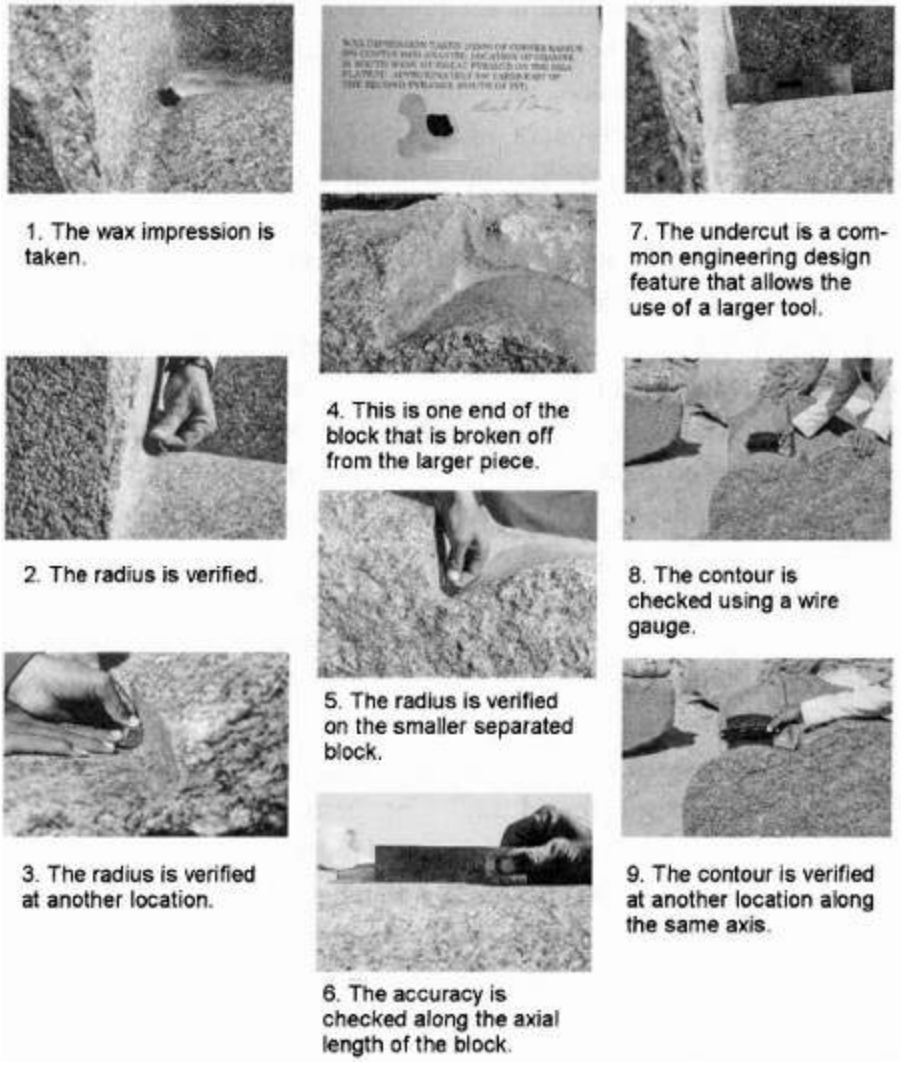

1. The wax impression is taken.
2. The radius is verified.
3. The radius is verified at another location.
4. This is one end of the block that is broken off from the larger piece.
5. The radius is verified on the smaller separated block.
6. The accuracy is checked along the axial length of the block.
7. The undercut is a common engineering design feature that allows the use of a larger tool.
8. The contour is checked using a wire gauge.
9. The contour is verified at another location along the same axis.

FIGURE 24. ***Contoured Block of Granite***

During this time, I had attracted quite a crowd. It is difficult to traverse the Giza Plateau at the best of times without getting attention from the camel drivers, donkey riders, and purveyors of trinkets. It was not long after I had pulled the tools out of my backpack that I had two willing helpers, Mohammed and Mustapha, who were not at all interested in compensation. At least that is what they told me, although I can say that I literally lost my shirt on that adventure. I had washed sand and dirt out of the corner of the

larger block and used a white T-shirt that I was carrying in my backpack to wipe the corner out so I could get an impression of it with forming wax. Mustapha talked me into giving him the shirt before I left, and I was so inspired by what I had found I tossed it to him. My other helper, Mohammed, held the wire gauge at different points along the contour while I took photographs of it. I then took the forming wax and heated it with a match—kindly provided by the Movenpick hotel—then pressed it into the corner blend radius. I shaved off the splayed part and positioned it at different points around. Mohammed held the wax still while I took photographs. By this time there were an old camel driver and a policeman on a horse looking on.

What I discovered with the wax was a uniform radius, tangential with the contour, the back, and the side wall. When I returned to the United States, I measured the wax using a radius gauge and found that it was a true radius measuring 7/16 inch. This, I believe, is a significant finding, but it was not the only one. The side (arm) blend radius, I found, has a design feature that is a common engineering practice today. The ancient machinists had cut a relief at the corner, a technique that modern engineers *use* to allow a mating part with a small radius to match or butt up against a surface with a larger blend radius. This feature provides for a more efficient machining operation because it allows the use of a cutting tool with a large diameter and, therefore, a large radius. This means that the tool has greater rigidity, and more material can be removed when making a cut.

I believe there is more, much more, that can be gleaned from ancient artifacts using these and other methods of study. I am certain that the Cairo Museum contains many artifacts that when properly analyzed will lead to the same conclusion that I have drawn from this piece—modern craftspeople and the ancient Egyptians have much in common in their use of the same kinds of machining techniques. The evidence, from granite artifacts at Giza and other locations, that ancient craftspeople used high-speed motorized machinery, and what we might call modern techniques in nonconventional machining such as ultrasonics, warrants serious study by qualified, openminded people who can approach the subject without prejudice or preconceived notions.

The implications of such discoveries are tremendous in terms of a more thorough understanding of the level of technology employed by the ancient pyramid builders. We are not only presented with hard evidence that seems to

have eluded us for decades and that provides support for the theory that the ancients were technically advanced. We are also provided with an opportunity to reanalyze history and the evolution—and devolution—of civilizations from a different perspective. But our understanding of *how* something was made opens up a different dimension when we then try to determine *why* it was made.

The precision in these artifacts is irrefutable. Even if we ignore the question of how they were produced, we are still faced with the question of why such precision was needed. Revelation of new data invariably raises new questions. In this case it is understandable for skeptics to ask, "Where are the machines?" But machines are tools, and the question should be applied universally and can be asked of anyone who believes other methods may have been used. The truth is that no tools have been found to explain *any* theory on how the pyramids were built or the granite boxes were cut. More than eighty pyramids have been discovered in Egypt, and the tools that built them have never been found. Even if we accepted the notion that copper tools are capable of producing these incredible artifacts, the few copper implements that have been uncovered do not represent the number of such tools that would have been used if every stonemason who is supposed to have worked on the pyramids at just the Giza site owned one or two. In the Great Pyramid alone there are an estimated 2,300,000 blocks of stone, both limestone and granite, weighing between two-and-one-half tons and seventy tons each. That is a mountain of evidence, and there are no tools surviving to explain even this one pyramid's creation.

The principle of Occam's razor, where the simplest means of manufacturing holds force until proven inadequate, has guided my attempt to understand the pyramid builders' methods. In the theory proposed by Egyptologists, the basic foundation of this principle is lacking. The fact is the simplest methods do not satisfy the evidence, and Egyptologists have been reluctant to consider other, less simple methods. There is little doubt in my mind that Egyptologists have seriously underestimated the ancient builders' capabilities. But they have only to look at the precision of the artifacts and the evidence for the mastery of machining technologies, which have been recognized in recent years, to find some answers. It would also help to try and understand modern manufacturing at the shop floor level. Primitive methods, though

simple to grasp intellectually, simply do not work in the field, and researchers would be well-served by gaining a better understanding of more sophisticated, ultra-precise methods.

One reference point for judging a civilization as advanced is to compare it with our current state of manufacturing evolution. Manufacturing is the physical manifestation of a society's scientific and engineering imagination and efforts. For over a hundred years industry has progressed exponentially. Since Petrie first made his critical observations of Egyptian artifacts between 1880 and 1882, our civilization has leapt forward technologically at breakneck speed. But, the development of machine-tools has been intrinsically linked with the availability of consumer goods and manufacturers' desire to find a customer. Most of our manufacturing development has been directed at providing the consumer with goods, which are created by artisans. Over a hundred years after Petrie, some artisans are still utterly astounded by the achievements of the ancient pyramid builders. They are astounded not so much by what they perceive a society is capable of creating using primitive tools, but rather by comparing these prehistoric artifacts with their own current level of expertise and technological advancement. To be objective, I must recognize that there are some artisans and engineers who resist revising their beliefs for the same reasons many Egyptologists do—they believe only "modern" societies are capable of sophisticated machining techniques. However, I would not be as bold in my assertions if I did not believe that the majority of my peers viewed the evidence with the same objectivity as I do and reached similar conclusions. I have presented this material to many engineers and artisans, and they are astonished at the evidence that is put before them.

To fully appreciate the value of this kind of research, we should keep in mind that the interpretation and understanding of a civilization's level of technology has predominately hinged on the preservation of written records. But for the majority of us, the nuts-and-bolts of our society do not always make interesting reading; in the same way, an ancient stone mural will more than likely have been cut to convey an ideological message rather than to preserve the information regarding the technique used to inscribe it. Moreover, the records of technology developed by our modern civilization rest in media that is vulnerable and could conceivably cease to exist in the

event of a worldwide catastrophe, such as a nuclear war or another ice age. Our legacy will likely be read in the tangible remains of our society. Consequently, after several thousand years, someone looking back would most probably arrive at a more accurate interpretation of us and our society from our artisans' *methods* rather than an interpretation of our *language. The language of science and technology does not have the same freedom as does speech.* So even though the Egyptian tools and machines have not survived the thousands of years since their use, we have to assume, by objective analysis of the evidence for them left behind in the artifacts, that these tools did indeed exist.

There is much to be learned from our distant ancestors, if only we can open our minds and accept that another civilization from a distant epoch may have developed manufacturing techniques that are as great as or perhaps even greater than our own. As we assimilate new data and new views of old data, we are wise to heed the advice Petrie gave to an American who visited him during his research at Giza. The man expressed a feeling that he had been to a funeral after hearing Petrie's findings, which had evidently shattered some favorite pyramid theory he had at the time. Petrie said, "By all means let the old theories have a decent burial; though we should take care that in our haste none of the wounded ones are buried alive."[3]

With such a convincing collection of artifacts that prove the existence of precision machinery in ancient Egypt, the idea that the Great Pyramid was built by an advanced civilization that inhabited the Earth thousands of years ago becomes more admissible. I am not proposing that this civilization was more advanced technologically than ours on all levels, but it does appear that as far as masonry work and construction are concerned they were exceeding current capabilities and specifications. Making routine work of precision machining huge pieces of extremely hard igneous rock is astonishingly impressive.

Considered logically, the pyramid builders must have developed their knowledge in the same manner any civilization would—reaching their state of the art through technological progress over many years. As of this writing, there is considerable research being conducted by professionals throughout the world who are determined to find answers to the many unsolved mysteries indicating that our planet has supported other advanced societies in

the distant past. Perhaps when this new knowledge and insight are assimilated, the history books will be rewritten and, if humankind is able to learn from historical events, then perhaps the greatest lesson we can learn is now being formulated for the benefit of future generations. New technology and advances in the sciences are enabling us to take a closer look at the foundations upon which world history has been built, and these foundations seem to be crumbling. It would be illogical, therefore, to dogmatically adhere to any theoretical point concerning ancient civilizations.

Such a revisioning occurred in 1986 when a French chemist named Joseph Davidovits rocked the world with a startling new theory on pyramid construction. Davidovits proposed that the blocks used to construct the pyramids and temples in Egypt were actually cast in place by pouring geopolymer materials into molds. In 1982, Davidovits analyzed limestone, given to him by French Egyptologist Jean-Philippe Lauer, which was taken from the Ascending Passage of the Great Pyramid and also the outer casing stones of the pyramid of Teti. In his book *The Pyramids: An Enigma Solved*, coauthored with Margie Morris, he reported:

> *X-ray chemical analysis detects bulk chemical composition. These tests undoubtedly show that Lauer's samples are man-made. The samples contain mineral elements highly uncommon in natural limestone, and these foreign minerals can take part in the production of geopolymeric binder.*
>
> *The sample from the Teti pyramid is lighter in density than the sample from Khufu's pyramid (the Great Pyramid). The Teti sample is weak and extremely weathered, and it lacks one of the minerals found in the sample from the Great Pyramid. The samples contain some phosphate minerals, one of which was identified as brushite, which is thought to represent an organic material occurring in bird droppings, bone, and teeth, but it would be rare to find brushite in natural limestone.*[4]

Davidovits' theory received worldwide attention, and I was challenged by several people to reconcile the theory that I was proposing with his. I have no difficulty reconciling my analysis of the cutting methods of the ancient pyramid builders with what Davidovits proposed. And I am sure he will see our individual efforts in the same light.

Davidovits cited *Pyramids and Temples of Gizeh,* in which Petrie devoted an entire chapter to the tool marks found on various artifacts made of both igneous and sedimentary rock. These artifacts were found both inside and outside the Great Pyramid. The tool marks on the stone tell us that they were cut, not poured. Nevertheless, this oversight should not entirely discredit Davidovits' findings. Construction technology today employs many techniques—cutting, forming, and pouring to name a few. Thus I believe it is shortsighted for me, or for anyone else, to discover one method of manufacture or construction and present it as the only method used by the pyramid builders.

Davidovits made a strong argument for his cast-in-place theory by pointing out the impossibility of the Egyptians having moved the huge monolithic blocks of stone that were used to build the pyramids. In most construction projects, if there is an option to do so, it does make sense to prepare a mold, or form, and pour the material, if the alternative is lifting and moving large masses weighing up to two hundred tons. Davidovits claimed that he had solved the problems associated with moving such huge stones with his cast-in-place theory. However, evidence that argues against the casting of igneous-type rock can be found in the rock tunnels at Saqqara. These are the giant granite and basalt boxes that weigh in at around eighty tons each. The existence of a roughed-out box and more than twenty finished boxes situated underground essentially disproves the argument that they were cast. We can speculate that when the craftspeople finished working the rough box, which is now wedged in one of the underground passageways, they would have had to move it into place without the benefit of hundreds of workers. That in and of itself is an impossibility. Furthermore, the very fact that this one box is rough cut belies the use of a casting method. If the Egyptians had cast these objects, they would not have chosen the characteristics of the roughed-out box for their mold. The product would be much closer to the finished dimensions of the other boxes, and more than likely the surfaces would be flatter than they actually are. These speculations do not mean that the ancient Egyptians did not use geopolymers. They simply mean that there may have been more than one method used to build the pyramids. To bring this whole issue into clearer perspective, perhaps we should now pause from evaluating the artifacts themselves and consider the work of an eccentric visionary who

came before Davidovits, a man who also claimed he knew the secret of how the pyramids of Egypt were built—and succeeded in proving it.

Chapter Six

THE CORAL CASTLE MYSTERY

While the cutting techniques of the ancient pyramid builders have been an ongoing topic for debate, they have not received the same attention and controversy as the methods that were used to lift and transport cyclopean blocks of stone. Egyptologists and orthodox believers of primitive methods argue that the huge blocks were moved and positioned using only manpower, but experts in moving heavy weights using modern cranes throw doubt on their theory.

My company recently installed a hydraulic press that weighs sixty-five tons. In order to lift it and lower it through the roof, they had to bring in a special crane. The crane was brought to the site in pieces transported from eighty miles away over a period of five days. After fifteen semitrailer loads, the crane was finally assembled and ready for use. As the press was lowered into its specially prepared pit, I asked one of the riggers about the heaviest weight he had lifted. He claimed that it was a 110-ton nuclear power plant vessel. When I related to him the seventy-and two hundred-ton weights of the blocks of stone used inside the Great Pyramid and the Valley Temple, he expressed amazement and disbelief at the primitive methods Egyptologists claim were used.

For many of us to whom the Egyptologists' orthodox theory seems implausible, it is enough just to argue the issue from a logical standpoint. For others, the debate becomes more meaningful when a proposed alternate method is demonstrated and proven to be successful. For that proof we must turn to the one man in the world who, by demonstration, has supported the claim, "I know the secret of how the pyramids of Egypt were built!" That man was Edward Leedskalnin, an eccentric Latvian who immigrated to the United States and who is now deceased. But he left many intriguing clues that persuade us he may indeed have known such secrets.

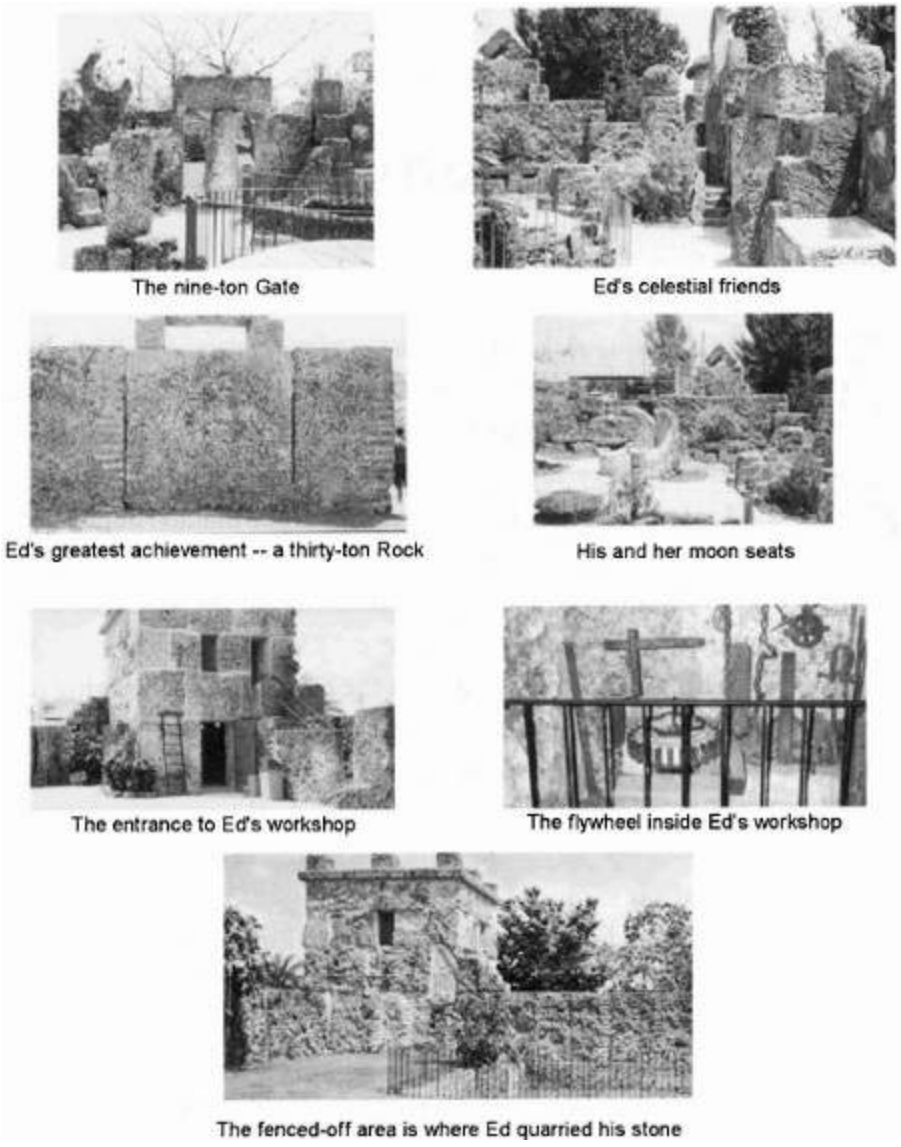

The nine-ton Gate
Ed's celestial friends
Ed's greatest achievement -- a thirty-ton Rock
His and her moon seats
The entrance to Ed's workshop
The flywheel inside Ed's workshop
The fenced-off area is where Ed quarried his stone

FIGURE 25. ***Assorted Photographs of Coral Castle***

Leedskalnin devised a means to single-handedly lift and maneuver blocks of coral weighing up to thirty tons. In Homestead, Florida, using his closely guarded secret, he was able to quarry and construct an entire complex of monolithic coral blocks in an arrangement that reflected his own unique character. On average, the weight of a single block used in the Coral Castle was greater than those used to build the Great Pyramid. He labored for twenty-eight years to complete the work, which consisted of a total of 1,100 tons of rock. What was Leedskalnin's secret? Is it possible for a 5-foot tall, 110-pound man to accomplish such a feat without knowing techniques that are undiscovered to our mainstream contemporary understanding of physics

and mechanics?

Leedskalnin was a student of the universe. Within his castle walls, he had a 22-ton obelisk, a 22-ton moon block, a 23-ton Jupiter block, a Saturn block, a 9-ton gate, a coral rocking chair that weighed 3 tons, and numerous other items. A huge 30-ton block, which he considered to be his major achievement, was crowned with a gable-shaped rock. Leedskalnin somehow single-handedly created and moved these massive objects without the benefit of cranes and other heavy machinery, a feat that astounds many engineers and technologists, who compare these achievements with those employed by workers handling similar weights in industry today.

Leedskalnin's castle was not always located in Homestead, Florida. He thought he had found his Shangri-la near Florida City and was happily working away on his rock garden until one night several thugs attacked him. Being a small man, he was an easy mark for these cowards, and he became a changed man after the trauma. Such was his concern that he became obsessed with moving his rock garden to a safer area. To assist him in the effort, he contracted with a local truck driver to haul his large rocks from Florida City to Homestead. As they prepared to load a 20-ton obelisk onto the truck, Leedskalnin asked the truck driver to leave him alone for a moment. Once out of sight, the truck driver heard a loud crash. Hurrying back to his truck, he was stopped in his tracks by the sight before him, hardly believing his eyes. He had returned just in time to *see* Leedskalnin dusting off his hands, the huge obelisk loaded and weighing down his flatbed.

Once in Homestead, the trucker was asked to leave his flatbed overnight and return in the morning. He was doubtful that Leedskalnin would be able to fulfill his promise that the obelisk would be off the truck and erected in the place he had set out for it. It's a good thing the truck driver did not bet money against Leedskalnin's ability to fulfill his word, because when he returned the following morning, Leedskalnin had moved the monolith into position, just as he had promised.

For his stupendous feats of construction engineering, Leedskalnin received attention not only from engineers and technologists, but from the United States Government, who paid him a visit, hoping to be enlightened. Leedskalnin received the officials gracefully, but they left none the wiser. In 1952, falling ill and on his last legs, Leedskalnin checked himself into the

hospital and slipped away from this life, taking his secrets about moving massive objects with him.

If we assume that Leedskalnin and the ancient pyramid builders were using similar techniques, we must reevaluate the requirements for the man-hours necessary to construct the Great Pyramid. Estimates provided by Egyptologists for the number of workers that built the Great Pyramid range between 20,000 and 100,000. Based on the abilities of this one man, quarrying and erecting a total of 1,100 tons of rock over a time span of twenty-eight years, the 5,273,834 tons of stone built into the Great Pyramid could have been quarried and put in place by only 4,794 workers. If we figure in the efficiencies to be gained from working in teams and the division of labor, we can reduce the number of workers and/or shorten the time needed to complete the task. Let us not forget the estimate given by Merle Booker of the Indiana Limestone Institute for the delivery of enough limestone to build a Great Pyramid. Using the same criteria—with respect to size and quantity—as the ancient builders, but using modern equipment, Booker estimated that all thirty-three Indiana limestone quarries would have to triple their average output to produce the stone. His estimate did not factor in any equipment failures, labor disputes, or acts of God. He estimated that *twenty-seven years* after the order was placed, the last stone would have been delivered! These numbers put Leedskalnin's accomplishments in their proper perspective.

I first visited Coral Castle in 1982 while vacationing in Florida. It soon became clear to me that Leedskalnin's claim was accurate—he did indeed know some secrets, perhaps even the very ones used by the ancient Egyptians. I returned to Homestead again in April 1995 to refresh my memory and, specifically, to closely examine a device that, in 1992, fueled a discussion between an engineer colleague, Steven Defenbaugh, and myself. Our discussion resulted in a speculation as to the methods that Leedskalnin had used.

Leedskalnin took issue with modern science's understanding of nature. He flatly stated that scientists are wrong. His concept of nature was simple: All matter consists of individual magnets, and it is the movement of these magnets within materials and through space that produces measurable phenomena—that is, magnetism and electricity and so on.

Whether Leedskalnin was right or wrong in his assertions, from his simple

premise he was able to devise a means to single-handedly elevate and maneuver large weights, which would be impossible using conventional methods. There is speculation that he was employing electromagnetism to eliminate or reduce the gravitational pull of the Earth. These speculations are entertained by some and scoffed at by others whose feet are firmly planted in the "real world."

While at Coral Castle, I commented to a lady standing in Leedskalnin's workshop that it was quite a feat he had performed, and asked if she had any idea how he had done it. Fixing me with a measured look, she said, "Through the application of physics and mechanics such work can be done." Somehow sensing my esoteric bent, she commented that Thor Heyerdahl had dispatched wild speculation about how the huge stone statues on Easter Island were put in place when he reenacted the work by carving, moving, and erecting one.

Being alone, and wanting a photograph taken of myself in Leedskalnin's workshop, I did not want to be argumentative. Smiling, I handed her the camera and did not point out that Heyerdahl, unlike Leedskalnin, had an ample supply of willing and healthy natives. They provided sufficient manpower to satisfy the physical requirements for conventionally moving such large weights, even on rollers, and cantilevering them into an upright position. Heyerdahl was an energetic man, but, using those methods, he could not have done it alone. Moreover, Heyerdahl merely demonstrated that the job could be done using one particular method. Anyone who has worked in manufacturing knows that there are many ways of doing things. To devise a means to perform a given work and present it as the only way that such work could be done gives little credit to those who either might know of a better way or might look for a better method—and succeed in finding one.

When analyzing ancient engineering feats, and being faced with explaining technically difficult tasks, Egyptologists and archaeologists typically throw in more time and more people using primitive, simple tools and manpower. Unlike those conventional arguments regarding ancient civilizations, in the case of Ed Leedskalnin we cannot impose the view that the work was done employing masses of people, for it is well-documented that Leedskalnin worked alone.

Egyptologists claim to "know" how the Great Pyramid was built. To prove it, stones no heavier than two-and-one-half tons were hefted into place using

a gang of workers, straining on ropes. Leedskalnin claimed to "know" how the Great Pyramid was built, and to prove it he moved a thirty-ton and other monolithic blocks of coral to build his castle. It is too bad the cameras were not on Leedskalnin as they were on the *NOVA* experiment. I believe that Leedskalnin's feat is more illustrative of the pyramid builders' methods. While I enjoyed *This Old Pyramid,* I was not too impressed with the results. After a tremendous amount of effort using modern tools and equipment, the crew managed to move a few blocks into place using only manpower. After recently talking to Roger Hopkins, who was the mason in charge of the construction of the pyramid for the *NOVA* film, I have a lot more respect for the effort and knowledge that he put into it under extremely arduous conditions. Hopkins is very straightforward and an honest craftsman who specializes in working in granite. Like me, he is convinced that the ancients were using state-of-the-art equipment to perform this work.

But the equipment and techniques Leedskalnin used, I would suggest, go beyond what we know as state of the art. What technique did he use? Can we regain the knowledge he took with him to his grave? What follows is a speculation about the techniques Leedskalnin may have used. It follows his basic premise regarding the nature of electricity and magnetism and leads to a conclusion that, I believe, has some semblance of logic. This speculation followed some basic rules for brainstorming—those that follow and that might eventually reveal the secret should do the same. First, there is no such thing as a stupid idea, and, second, what we have been taught about the subject may not necessarily apply when seeking and, hopefully, finding a real solution.

A paradigm shift in my perception of "antigravity" occurred when my coworker, Steven Defenbaugh, and I were discussing the subject with Judd Peck, the CEO of the company for which we both work. Peck asked the simple question, "What is antigravity?" In an attempt to define it I had to say, "A means by which objects can be lifted, overcoming the gravitational pull of the Earth." As I spoke, it occurred to me that we were already applying antigravitational techniques in our everyday life. When we get out of bed in the morning, we employ antigravity just by standing up. An airplane, a rocket, a forklift truck, and an elevator are technologies devised to overcome the effects of gravity. Even a car rolling along on its wheels is an antigravity

device. Without the wheels and a propulsion system, it would be just dead weight.

I realized that I had been laboring under the assumption that in order to create an antigravity device, gravity should be a known and fully understood phenomenon and that, through the application of technology, out-of-phase gravity waves would have to be created in such a manner as to neutralize it. As any physicist will tell you, the nature of gravity still eludes us, as does the ability to produce interference gravity waves.

So what if there is no such thing as gravity? What if the natural forces we already know about are sufficient to explain the noted phenomenon we have labeled as gravity? If, as Leedskalnin claimed, all matter consists of individual magnets, wouldn't the known properties of a magnet be sufficient? We know that like poles repel, and unlike poles attract. We also know that we can suspend one magnet above another as long as we do not allow either of them to flip over so that the opposite poles attract each other. Magnets seek to attract and, left to themselves, will align their opposite poles to each other. A mag-lev train is a good example of an antigravity device employing magnets.

The Earth, having the properties of a large magnet, generates streams of magnetic energy that follow lines of force. These lines of force have been noted for centuries (see Figure 26). If we assume, as Leedskalnin did, that all objects consist of individual magnets, we also can assume that an attraction exists between these objects due to the inherent nature of a magnet seeking to align its opposite pole to another. Perhaps Leedskalnin's means of working with the Earth's gravitational pull was nothing more complicated than devising a means by which the alignment of magnetic elements within his coral blocks was adjusted to face the streams of individual magnets he claimed are streaming from the Earth with a like repelling pole.

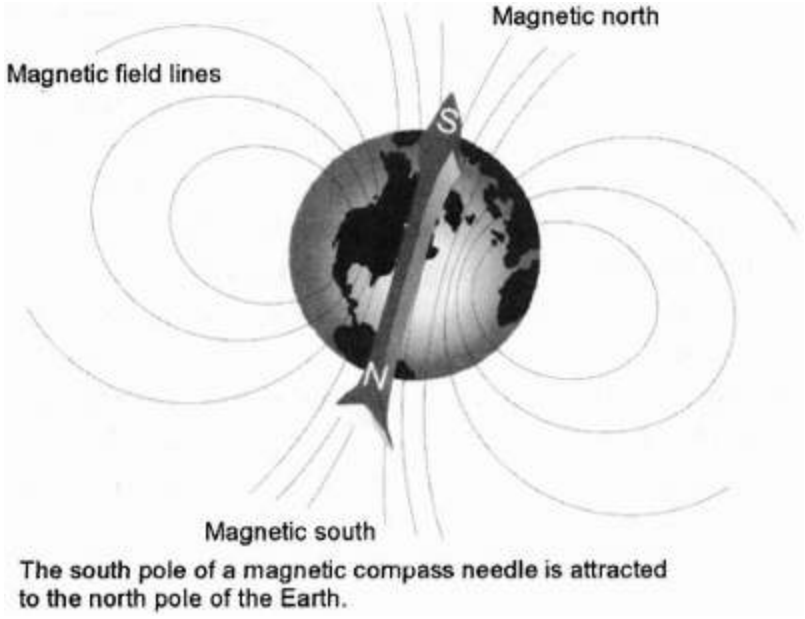

Magnetic north
Magnetic field lines
S
N
Magnetic south
The south pole of a magnetic compass needle is attracted to the north pole of the Earth.

FIGURE 26. ***Poles of Bar Magnet and Earth***

A well-known method for creating magnetism in an iron bar is to align the bar with the Earth's magnetic field and strike the bar with a hammer. This blow vibrates the atoms in the bar and allows them to be influenced by the Earth's magnetic field. The result is that when the vibration stops, a significant number of the atoms have aligned themselves within this magnetic field.

Was this the method that Leedskalnin was using? It is a simple concept, and when I observed the devices in Leedskalnin's workshop, I could easily imagine the application of vibration and electromagnetism. His flywheel for creating electricity remains motionless, for the most part, until inquisitive tourists like me come along and give it a spin. After giving it a few revolutions, I realized that something was missing. The narrative I heard, while browsing around the castle, described Leedskalnin as using this device to create electricity to power his electric lightbulbs. It was claimed that Leedskalnin did not have electricity, but I could not imagine this device being a useful and continuing source of power, considering Leedskalnin used only his right arm to turn the wheel. On closer examination of the piece, I found that the whole assembly was actually an old four-cylinder crankcase. His flywheel was mounted on the front end of the crankshaft and consisted of bar magnets that were sandwiched between two plates—the upper plate being a ring gear. To give it weight and to solidify the entire assembly, Leedskalnin

had encased the bar magnets with cement. It then occurred to me that the photo of Leedskalnin with his hand on the crank handle—which is attached to the end of the shaft—may not accurately represent his entire operation. It is possible that Leedskalnin was using the crank handle to start a reciprocating engine, now missing, which attached to one of the throws on the crankshaft. He would then be able to walk away and leave his flywheel running.

I was now mystified. I had developed a notion that the bars attached to the flywheel were actually being used to develop vibration in the piece Leedskalnin was trying to lift. This idea did not make sense considering the type of material, size, and weight of the entire assembly. The crankcase was firmly attached to the coral block in his workshop, and even if it was not attached, it would be quite a feat to keep moving it about. There was one factor I needed to check out, though, before I headed back to Illinois. I had tested the bar magnet with a pocketknife. The knife was attracted to each bar. I needed to know, conclusively, the arrangement of the poles in the wheel—to see, indeed, whether the assembly was capable of creating electricity.

I headed for the nearest strip mall to look for a hardware store so that I could buy a bar magnet. The first one had just what I needed—and for only $1.75. Feeling rather pleased, I returned to Coral Castle.

Once there, I headed back into Leedskalnin's workshop and put the magnet to the test. I held it a short distance away from the spokes of the flywheel while giving it a spin. Sure enough, I found out what I had come for. The magnet pushed and pulled in my grasp as the wheel rotated. Looking around the space, I gazed at a jumble of various devices, lying, hanging, and leaning about the room (see Figure 27). There were radio tuners, bottles with copper wire wrapped around them, spools of copper wire, and other various and sundry plastic and metal pieces that looked as if they had fallen out of an old radio set. Leedskalnin's workshop also contained chains, block and tackle, and other items that one might find lying around a junkyard. Some items were missing, though. Photographs of Leedskalnin at work show three tripods—made of telephone poles—that have boxes attached to the top. These objects, however, are not to be found at Coral Castle. What is striking in the photograph is that the block of coral being moved is seen off to the side of the tripod. Perhaps Leedskalnin had moved the tripod after raising the block out of the bedrock. Another interesting observation is that the block

and tackle that can be found inside his workshop is nowhere to be seen in this photograph. There are spools of copper wire in his workshop, and two wrappings of copper wire hang from nails in the wall. One was round copper and the other flat copper. In a narrative that visitors can hear at various recording stations around the compound, it is stated that at one time Leedskalnin had a grid of copper wire suspended in the air. Looking at the photograph again, one can see that there is a cable draped around the tripod and running down to the ground. Perhaps the arrangement of tripods was more related to the suspension of his copper grid than to the suspension of block and tackle.

FIGURE 27. ***Ed Leedskalnin's Workshop***

If I were to try to replicate Leedskalnin's feat, I would begin with the premise that he was using his flywheel to generate a single-frequency tunable radio signal. The box at the top of the tripod would contain the radio receiver (there are several tuners in Leedskalnin's workshop), and the cable coming from the box would be attached to a speaker that emitted sound to vibrate the coral rock at its resonant frequency. With the atoms in the coral vibrating (like those in an iron bar), I would then attempt to flip their magnetic poles—which are naturally in an attraction orientation with the Earth—using an electromagnetic field.

Although today we stand in amazement before ancient megalithic sites that were built employing huge stones, if we had Leedskalnin's technique for lifting huge stones, it would make sense to us that the ancient masons might make their building blocks as large as possible. Very simply, it would be more economical to build in that manner. If we had a need to fill a five-foot cube, the energy and time required to cut smaller blocks would be much greater than what would be required to cut a large one.

I have no doubt that Leedskalnin told the truth when he said he knew the secrets of the ancient Egyptians. Unlike those who have sought publicity for their own inadequate, although politically correct, theories, he proved his theory through his actions. I believe, also, that we can rediscover his techniques and put them to use for the benefit of humankind. Edward Leedskalnin, right or wrong, had a little bit of a problem with trust—but this modus operandi was not unusual for a craftsperson of his day. Proprietary techniques without patent disclosure assure continued employment; therefore, it was perfectly normal that he would protect his secret from prying eyes that might steal and profit from it. I believe there are enough pieces of the puzzle in Leedskalnin's workshop to allow us to put them together and replicate his technique. It has been done once (sorry, twice!), and I am sure that it can be done again.[1]

Chapter Seven

ENDEAVORING TO EXPLAIN THE ENIGMA

As we have seen, the evidence carved into the granite artifacts in Egypt clearly points to manufacturing methods that involved the use of machinery such as lathes, milling machines, ultrasonic drilling machines, and high-speed saws. They also possess attributes that cannot be produced without a system of measurement that is equal to the system of measure we use today. Their accuracy was not produced by chance, but is repeated over and over again.

After I assimilated the data regarding the ancient Egyptians' manufacturing precision and their possible and—in some instances—probable methods of machining, I suspected that to account for the level of technology that the pyramid builders seem to have achieved, they must have had an equally sophisticated energy system to support it. One of the pressing questions we raise when we discuss ancient ultrasonic drilling of granite is, "What did they use as a source of power?" A still more forceful inquiry regarding the use of electricity necessary to power ultrasonic drills or heavy machining equipment that may have been used to cut granite is, "Where are their power plants?" Obviously there are no structures from the ancient world that we can point to and identify as fission reactors, or turbine halls. And why should we have to? Isn't it a bit misguided of us to form an assumption that the ancient power plants were even remotely similar to ours?

Nevertheless, there may be some fundamental similarities between ancient and modern power supplies, in that the power plants in existence today are quite large and all need a supply of water for cooling and steam production. If such an advanced society existed in prehistory and if indeed they had an energy system, we could logically surmise that their power plants in all probability would be the largest construction projects they would attempt. It also may follow that, as the largest creations of the society, those power

plants would stand a good chance of surviving a catastrophe and the erosion of the elements during the centuries that followed.

The pyramids easily meet these requirements. These geometric relics of the past, which have been studied, speculated about, and around which so much debate has centered, are located near a water supply, the Nile River, and, indeed, are the largest building projects that this ancient society completed. In light of all the evidence that suggests the existence of a highly advanced society utilizing electricity in prehistory, I began to seriously consider the possibility that *the pyramids were the power plants of the ancient Egyptians.*

Like just about every other student of the Egyptian pyramids, my attention was focused on the Great Pyramid, primarily because this is the one on which everybody else's attention had been focused, resulting in more research data being available for study. The reports of each successive researcher's discoveries inside the Great Pyramid are quite detailed, especially Petrie's. It is as though researchers became obsessed with reporting data, regardless of how insignificant it may have seemed.

Researchers have especially noted the Great Pyramid's geometric dimensions. Having worked with dimensions and angles all my working life —not just for the sake of dimensions themselves—their relevance in the Great Pyramid, while being important, was not of a primary concern to me. The dimensions, after all, are not the object, but a means to create the object. The area of study that I felt would reveal the true purpose of the Great Pyramid was a thorough examination of the inner chambers, passages, and every little detail that has been noted within them. While I was studying the inner chambers and passages of the Great Pyramid, I became convinced that I was looking at the prints for an extremely large machine, except this machine had been relieved of its inner components for some inexplicable reason. It is difficult to envision a machine that big, but with this basic premise I studied the drawings a little closer in order to obtain an understanding of how it might have operated.

The tremendous amount of masonry used in constructing this edifice suggested to me that there were things happening inside this pyramid that made such quantity necessary. Also, it seemed that the only logical reason an advanced civilization would have to build such a structure, at an obviously vast expenditure of time and energy, would be the same and only reason our

civilization would need to duplicate it—to provide the population with some return on their investment. Energy would be such a return.

At the time the early explorers were crawling through the Great Pyramid, science and technology were at such a point that the basic foundations for explaining its true purpose had not yet been laid. At that time in our technological history, it would have been impossible for those researchers to entertain the thoughts recorded in this book; therefore, it is true to say that the science embodied in the Great Pyramid was lost to early explorers. But is this ancient science still lost?

I believe that the scientific foundation has been laid to attain that elusive lost science. In proposing my theory that the Great Pyramid is a power plant, I am not adamantly adhering to anyone proposition. The possibilities may be numerous. However, the main facts are inescapable, for they were noted many years ago, and it would be impossible for an open-minded, logically thinking person to disregard them.

As we head toward the new millennium, the interest in ancient civilizations and the pyramids is gaining momentum. The idea that the Great Pyramid of Giza was built for the generation or as a source of energy is not new. Other authors have alluded to this idea and have made valuable contributions in the research of the Great Pyramid.

It is an exciting time we are living in. New information coming from Giza indicates that the theory that follows will find more evidence and proof to support it. Rudolph Gantenbrink's exploration in 1993 provided some of that proof, as I will shortly discuss. And testing in the Great Pyramid's King's Chamber by Tom Danley of the Schor expedition—though currently shrouded in secrecy imposed by a nondisclosure agreement—promises to reveal a tremendous amount of new and relevant information. Through the efforts of these researchers, and the groundwork laid by generations of others' enlightenment is about to dawn in the hazy world of Egyptology and we can be confident that the real truth about our distant ancestors in prehistory will soon come to light. The theory that follows, and the evidence I have gathered to support it, will, I hope, bring us one step further into the light of awareness about our species—where we were, where we are, and where we may be heading.

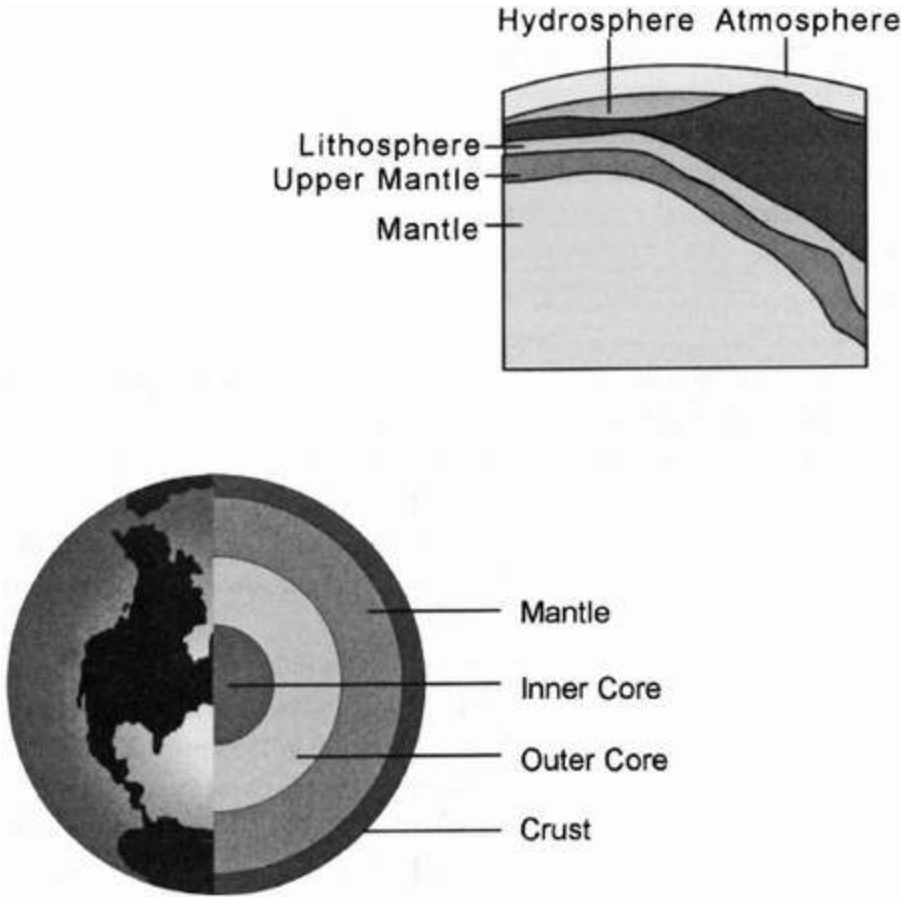


FIGURE 28. ***The Earth's Layers***

Chapter Eight

THE GIZA POWER PLANT

*The Earth is a dynamic, energetic body that has supported civiliza*tion's demand for fuel for centuries. To date this demand has predominantly been for energy in the form of fossil fuels. More recently, scientific advances have allowed us to tap into the power of the atom, and further research in this area promises greater advances in the future. There is, however, another form of abundant energy in the Earth that in its most basic form has, for the most part, been largely ignored as a potential source of usable energy. It usually gets our attention when it builds up to a point of destruction (see Figure 28).

That energy is seismic, and it is the result of the Earth's plates being driven by the constant agitation of the molten rock within the Earth. Most earthquakes are the result of a shifting of these large, ridged blocks of rock, or plates, that compose the Earth's surface. In a process called plate tectonics, these plates are thrust against each other, away from each other, and side to side. They do not slip freely, but build up energy over time and then slip in a jerky fashion. Each jerk causes an earthquake because elastic energy stored in the rock is suddenly released as seismic energy in the form of waves that spread outward from the epicenter. The boundaries between these blocks of rock are called faults, and it is at these points where the sudden shift occurs. (The San Andreas Fault is probably the most widely known fault in North America.) Also contributing to strain within the Earth's crust is the gravitational relationship between the Earth and the moon. The tides are contained not only within the oceans of the world; the continents, too, are in constant movement, rising and falling as much as a foot as the moon orbits the Earth.

These earthquake vibrations produced in the Earth's outer layer, or crust, can range from barely noticeable to catastrophically destructive. There are six

kinds of shock waves generated in the process (see Figure 29). Two types, known as body waves, travel through the Earth's interior, whereas the other four are surface waves. The movement of the rock distinguishes one kind of wave from another. Primary or compressional waves (P waves) send particles oscillating back and forth in the same direction as the waves are traveling. Secondary or transverse shear waves (S waves) oscillate perpendicular to their direction of travel. P waves always travel at higher velocities than S waves and are the first to be recorded by a seismograph.

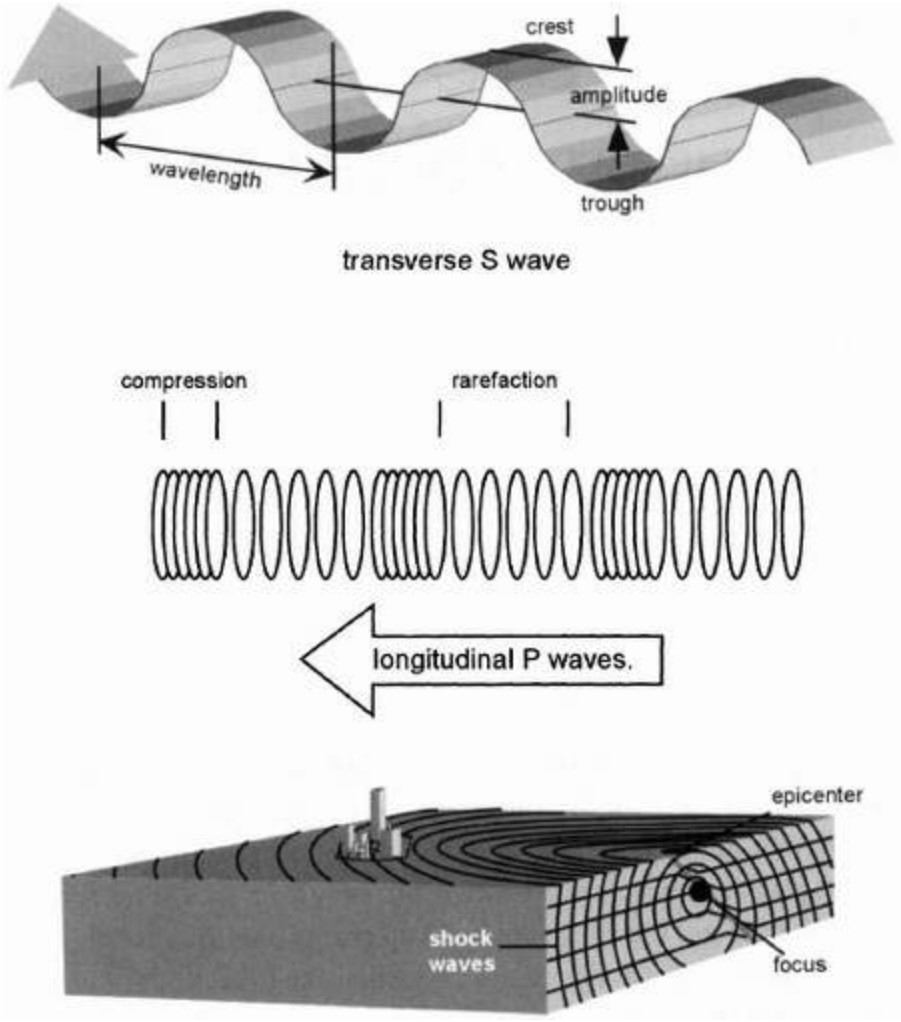


FIGURE 29. ***Types of Seismic Waves***

Scientists believe that the Earth is analogous to a giant dynamo, with convection currents of charged molten metal circulating in the Earth's core. It is this flow of electric current in the core that generates its magnetic field (see Figure 30). Scientists have not yet seen the magnetism created by this flow of

electricity as a potential source of energy because this field's force is relatively weak. Perhaps future technological innovations, of the kind that I suspect Edward Leedskalnin was using, will enable us to harness the Earth's electrical and magnetic energies. Who can say what doors new discoveries will open? The need for energy is ongoing, and as long as so much attention is focused on this subject, a decade should see many new innovations and changes.

With these considerations in mind, it would be helpful if we study another form of energy that is associated with a dynamo as the potential "raw material" for the production of power. Turn on any motor or generator and you can hear the energy at work: The motor/generator will hum as it revolves. This hum is associated with the energy itself and not so much the movements of the rotor through the air. This phenomenon is evident when a motor stalls while the power is still turned on. When too great a load is put on a motor, and the motor stalls, the hum will become louder. The electrical and magnetic forces in the motor generate the sound waves. The Earth itself, as a giant dynamo, produces similar sound waves. The following is a brief explanation of this phenomenon:

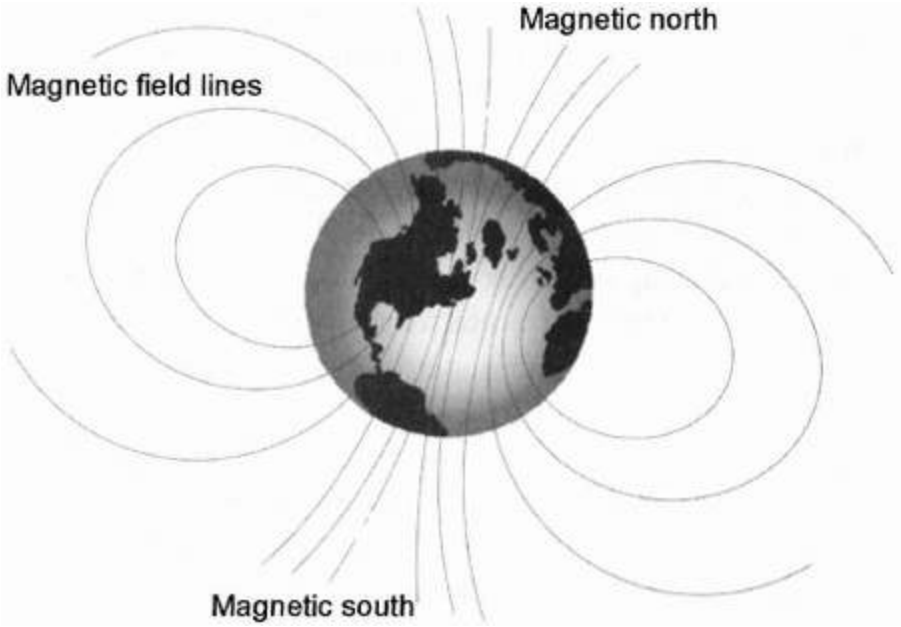


FIGURE 30. ***Magnetic Fields of the Earth***

Any local change in the density of an elastic medium can serve as a source for sound. This accounts for the great variety of acoustic sources

because density changes may be produced in a great many ways, including mechanical, thermal, electrical, magnetic, and chemical actions. The most common sound waves are produced by the mechanical vibrations of solids, liquids, and gases. Solid vibrators include strings and rods, membranes and plates, shells (e.g., bells), as well as three-dimensional extended objects like the Earth itself. Liquid sources are not as common, but the turbulent flow of water or air provides an example. Gaseous sources include organ pipes, whistles, singing flames and explosions, as well as turbulent airflow.[1]

There has been much discussion of late about the increasing frequency of the pulse of the Earth. There are speculations that the primary mode frequency appears to be gradually shifting higher, which therefore lends support to the belief that we are in for some significant Earth changes. Known as the Schumann Resonance, after German physicist W. O. Schumann who predicted the phenomenon between 1952 and 1957, these fundamental vibrations are the result of electrical activity between the Earth and its upper atmospheric layers. Collectively known as an electromagnetic "cavity," the elements that make it up are the Earth, the ionosphere, the troposphere, and the magnetosphere. The fundamental frequency of the vibrations is calculated to be 7.83 hertz, with overlaying frequencies of 14, 20, 26, 32, 37, and 43 hertz.[2]

Other researchers, however, contradict the idea that the Schumann Resonance is quickening because its frequency is related to the physical dimensions of the planet and the dimensional and electrical relationship between the surface of the Earth and the outer atmospheric layers. To increase the frequency would necessitate either a drastic change in the dimensions of the planet or the relocation of these outer layers to many miles within the Earth. Like a guitar string that has a fixed length, or boundary, within which it will vibrate in response to the input of energy, the Schumann Resonance is the result of electrical activity within the boundaries made up of the surface of the Earth and the outer atmospheric layers. The tension, or resistance, to the energy in a guitar string can be variable, but in the atmosphere it is fixed at around 200 ohms.

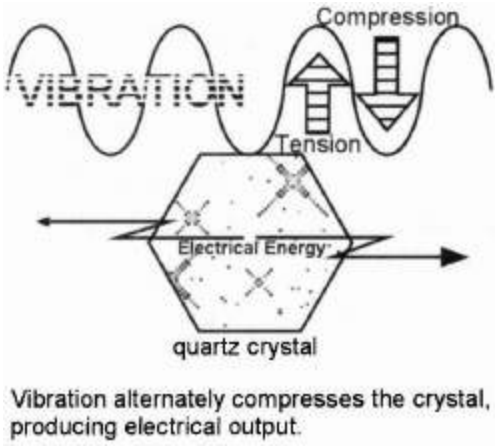


FIGURE 31. ***The Piezoelectric Effect***

The Earth's energy includes mechanical, thermal, electrical, magnetic, nuclear, and chemical action, each a source for sound. It would follow, therefore, that the energy at work in the Earth would generate sound waves that would be related to the particular vibration of the energy creating it and the material through which it passes. The audible hum of an electric motor—operating at 3,600 rpm—would fall well below the level of human hearing if it were to slow down to one revolution every twenty-four hours, as in the case of the Earth. What goes unnoticed as we go about our daily lives is our planet's inaudible fundamental pulse, or rhythm.

On the other end of the scale, any electrical stimulation within the Earth of piezoelectrical materials—such as quartz—would generate sound waves above the range of human hearing (see Figure 31). Materials undergoing stress within the Earth can emit bursts of ultrasonic radiation. Materials undergoing plastic deformation emit a signal of lower amplitude than when the deformation is such as to produce cracks. Ball lightning has been speculated to be gas ionized by electricity from quartz-bearing rock, such as granite, that is subject to stress.

It is not surprising that any sound generated by the electrical, magnetic, thermal, mechanical, and chemical action of the Earth goes unnoticed. With the influence of the ambient noise that surrounds us and that we create in our daily lives, we have managed to tune out any Earth sounds that may reach our ears. The birds, insects, and rustling of winds in the trees fill the countryside air with sound, and the large cities literally hum with activity.

As electrical energy can create mechanical vibrations (perceived as sound

by the human ear), so in turn can mechanical vibrations create electrical energy, such as the previously mentioned ball lightning. It could be theorized, therefore, that with the Earth being a source for mechanical vibration, or sound, and the vibrations being of a usable amplitude and frequency, then the Earth's vibrations could be a source of energy that we could tap into. Moreover, if we were to discover that a structure with a certain shape, such as a pyramid, was able to effectively act as a resonator for the vibrations coming from within the Earth, then we would have a reliable and inexpensive source of energy.

So let us look at the Great Pyramid and its relationship to the Earth. Some incredible data have been recorded concerning the Great Pyramid that give us a clear insight into the builders' need to build a precise and close association with our planet. It could be passed off as coincidence that the Great Pyramid is located at the center of Earth's landmass (see Figure 32), but other characteristics of this structure strongly emphasize a close relationship to the Earth that is too significant to be overlooked.

When John Taylor wrote of the Great Pyramid, "It was *to make a record of the measure of the Earth* that it was built,"[3] he was basing this conclusion on his evaluation of some astounding mathematical analyses, which had emerged through his research into the measurements of the Great Pyramid. He continued, "They knew the Earth was a sphere; and by observing the motion of the heavenly bodies over the Earth's surface, had ascertained its circumference, and were desirous of leaving behind them a record of the circumference as correct and imperishable as it was possible for them to construct."

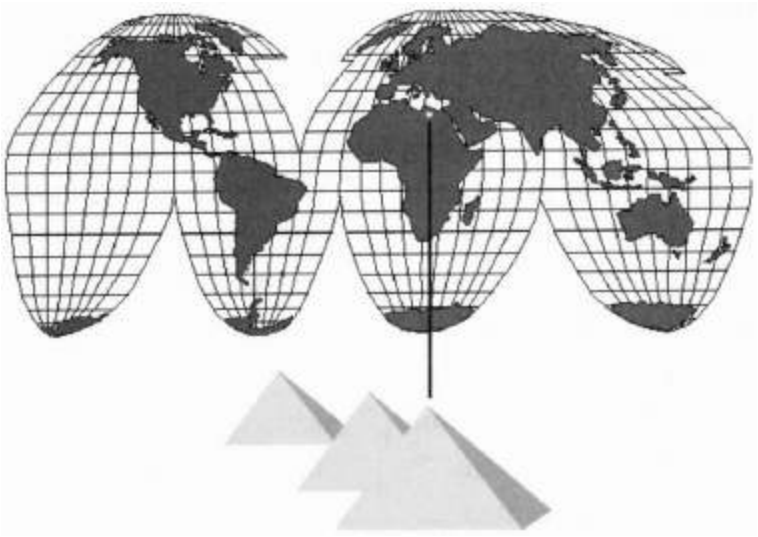


FIGURE 32. ***Center of Earth's Landmass***

It was the discovery of the knowledge of the transcendental number of pi (π) in the Great Pyramid that prompted Taylor to conclude that the perimeter of the Great Pyramid could be analogous to the circumference of the Earth at the equator. The height would represent the distance from the center of the Earth to the poles. Further studies of the dimensions of the Great Pyramid revealed surprising inferences regarding the knowledge of its builders. When searching for a unit that would fit the pyramid in whole numbers yet still retain the pi proportion, Taylor's answer of 366 base and 116.5 height suggested to him that the Egyptians may have divided the perimeter of the Great Pyramid into segments of the solar year. He also found the figure 366 when he divided the base of the pyramid by 25 inches. This suggested that the British inch was close to the Egyptian unit of measure, with 25 such units making one cubit.

It was later concluded that the Egyptian unit of measurement exceeded that British inch by .0011 inch, and Taylor found that this unit fit the Great Pyramid in multiples of 366. Even more astounding, geodetic research of the Earth established the Egyptian inch as an accurate unit of the dimensions of the polar radius. Peter Tompkins, in *Secrets of the Great Pyramid*, wrote: "To Taylor the inference was clear: the ancient Egyptians must have had a system of measurements based on the true spherical dimensions of the planet, which used a unit which was within a thousandth part of being equal to a British inch."[4] It was speculated that the British inch has lost a thousandth part after

many generations of use.

Piazzi Smyth was a supporter of John Taylor and communicated with him frequently. Following Taylor's death in 1864, Smyth was able to confirm his calculations and also his correlation between the Great Pyramid and the Earth: ". . . and there appears to be further an even commensurability of a most marvelous order, between the weight of the whole Great Pyramid and the weight of our planet earth. *The Great Pyramid itself, found to be Harmoniously Commensurable with the Earth, by Weight of the whole."*[5] Smyth calculated the weight of the Great Pyramid to be 5,273,834 pyramid tons and the weight of the Earth to be 5,273,000,000,000,000,000,000 pyramid tons. As such, he calculated it to be a 10^{15} integer of the Earth's weight.[6]

To review Taylor's findings:

- A pyramid inch is .001 inch larger than a British inch. There are 25 pyramid inches in a cubit and there were 365.24 cubits in the square base of the Great Pyramid.
- There are 365.24 days in a calendar year.
- One pyramid inch is equal in length to 1/500 millionth of the Earth's axis of rotation. This relationship suggests that not only were the builders of the Great Pyramid knowledgeable of the dimensions of the planet, they based their measurement system on them.

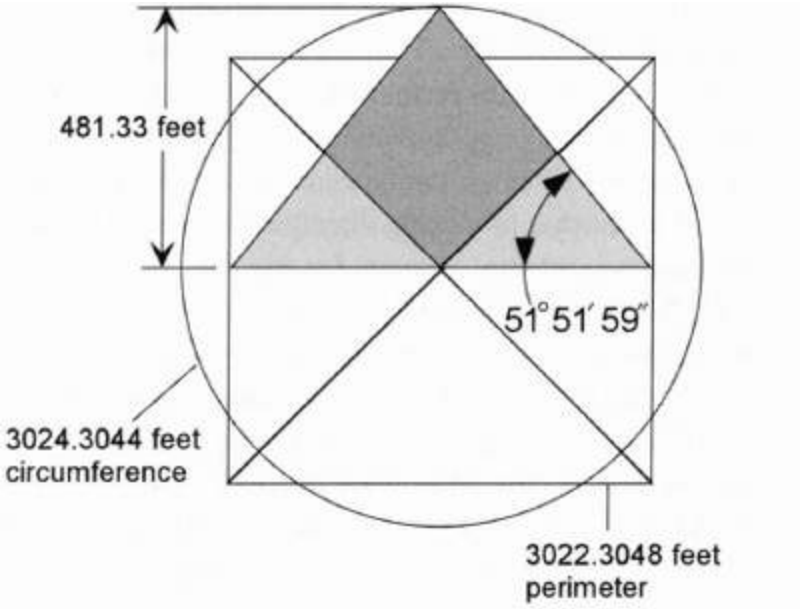
What else is unique about the Great Pyramid? Although it is a pyramid in shape, its geometry possesses an astounding approximation to the unique properties of a circle, or sphere. The pyramid's height is in relationship with the perimeter of its base as the radius of a circle is in relationship with its circumference. A perfectly constructed pyramid with an exact angle of 51°51' 14.3" has the value pi incorporated into its shape (see Table 2).

Pi (3.1415926) is an incommensurable number that, before calculators were invented, engineers used to round off to a three-or four-place decimal. It is startling to read, therefore, that in 1883 Petrie published his painstaking measurements of the Great Pyramid and recorded the following: "On the

whole, we probably cannot do better than take 51°52' ± 2' as the nearest approximation to the mean angle of the Pyramid, allowing some weight to the South side. The mean base being 9068.8 ± .5 inches, this yields a height of 5776.0 ± 7.0 inches."[7]

TABLE 2

	Petrie's Measurements	
Length of one side	9068.8 inches	755.733 feet
Perimeter (length x 4)	36275.2 inches	3022.93 feet
Height	5776.0 inches	481.33 feet
Angle based on above measurements	51°51'59"	
The Great Pyramid's approximation to pi based on Petrie's measurements	3.14017 (see Figure 33)	



Description	Value
Height of pyramid in feet	481.333 feet
Angle of pyramid at base	51°51′59″
Calculated length of one side	755.733 feet
Total perimeter	**3022.93 feet**
Radius of circle (R)	481.333 feet
Pi	3.141592654
Circumference (=R*2*Pi)	**3024.30 feet**

FIGURE 33. ***The Pi Factor***

William Fix presented well-founded and objective data to support this

claim: "We know that someone in very deep antiquity was aware of the size and shape of the earth with great precision. The three key measurements of the earth are incorporated in the dimensions of the Great Pyramid. The perimeter of the Pyramid equals a half minute of equatorial latitude. The perimeter of the sockets equals a half minute of equatorial longitude, or 1/43,200 of the earth's circumference. The height of the Pyramid including the platform, equals 1/43,200 of the earth's polar radius.... We do not know how they measured it, but that they did so is now an article of knowledge."[8]

There are volumes written on the measurements taken of the Great Pyramid, with each researcher producing slightly different results than the others. I am not going to attempt to argue for one data set or the other; however, I prefer Petrie's more realistic and "real-world" approach in reporting his data in that he provides a tolerance band within which his measurement may fall. Within the tolerance band he gave for the angle of the pyramid, we could have taken the perfect pi proportion, but it really is not necessary for the purposes of this book. What I have established by providing this data is that there is a distinct relationship between the Great Pyramid and the Earth. This is evidenced by the measurements of the pyramid and by its location.

When we question *why* there is a correlation between the Earth's dimensions and the Great Pyramid, we come up with three logical alternatives. One is that the builders wished to demonstrate their knowledge of the dimensions of the planet. They felt it necessary to encapsulate this knowledge in an indestructible structure so that future generations, thousands of years in the future, would know of their presence in the world and their knowledge of it.

The second possible answer could be that the Earth affected the function of the Great Pyramid. By incorporating the same basic measurements in the pyramid that were found on the planet, the efficiency of the pyramid was improved and, in effect, it could be a harmonic integer of the planet.

A third alternative may involve both the first and the second answers. The dimensions incorporated in the Great Pyramid may have been included to demonstrate the builders' knowledge or more importantly, to symbolize the relationship between the Great Pyramid's true purpose and the Earth itself. Perhaps the dimensions were not a critical requirement for the function of the

pyramid, but were included to satisfy the aesthetic nature of the builders.

Considering the degree of practical consciousness evident in the Great Pyramid, I am inclined to accept a practical answer for noted phenomena and choose the second alternative because it recognizes a level of pragmatism that such a degree of consciousness would undoubtedly possess. The second alternative leaves no doubt that the builders of the Great Pyramid did not go to a vast amount of trouble simply to pass along their knowledge to some future generation. They used their energies for a more self-serving and timely purpose. That the builders of the Great Pyramid employed the dimensions of the Earth in their pyramid as a means to an end in achieving a specific result is easier to accept than the speculation that it was the result of some magnanimous gesture intended for future generations. Could our society afford to build—if we were able to—such a structure for this purpose?

Having established the relationship between the Great Pyramid and the Earth, it would be helpful if we remind ourselves that the measurements of an object are not the object itself but a means to create the object—or a means to an end. With the Great Pyramid the means are clearly evident. To what end they were used will become more obvious as we move along.

We know that the Earth is a vibrating dynamic body with tremendous forces that build up over time, forces that eventually result in a sudden release of a tremendous amount of energy. We might ask, therefore, "How can we tap into that energy?" Is there a way to draw the energy off over a period of time, thereby decreasing its intensity and possibly precluding the destructive forces of an earthquake? Science has shown us that it is possible, on a much smaller scale, for an object to draw mechanical energy from another vibrating object if both their vibrating frequencies are in harmony. But to draw mechanical energy out of the Earth would be a huge task. What would the requirements be for the object that we would use to accomplish such a thing?

Before we can answer these questions, we must refresh our minds regarding *resonance* and *harmonics,* for these are the natural phenomena that we would need to work with to accomplish such a task (see Figure 34). Resonance is the sympathetic vibration of one object with another. A piano provides a simple example of resonance. Press down one key, or several keys forming a chord, without actually striking the note, and then undamp the strings by pressing the loud pedal. Play the corresponding notes an octave

higher, and the strings you have open on the lower octave will vibrate in sympathy. Hum into the piano in the same pitch and the strings will again respond. This transfer of energy is due to resonance. The transmission of energy and vibration go hand in hand. The strings of a musical instrument are induced to vibrate, and the energy reaches our ears in the form of sound waves.

When airborne sound forces mechanical vibrations in several piano strings that vibrate at different frequencies, the phenomenon known as harmonics is at work. Elements (strings) will absorb energy from a source more efficiently if they are of the same frequency. Multiples of the fundamental forcing frequency, known as harmonic frequencies, also will efficiently absorb this energy and vibrate at their natural resonance.

Resonance can probably best be described by a classic example of how this natural phenomenon can unleash an awesome and destructive power. This incident occurred on the morning of November 7,1940, in the State of Washington. The Tacoma Narrows Bridge created a link between the Olympic Peninsula and the mainland. It had been open only for four months when tragedy struck. In gusts of wind at only forty-two miles per hour, the bridge began to oscillate, wildly swaying back and forth. The gusts of wind swept across the bridge at a frequency that matched the bridge's natural resonant frequency. As the gusts of wind continued, the bridge's torsional vibrations amplified to the point that the suspenders were torn away from their moorings and the bridge began to break up. Fortunately, it was closed to traffic in time, and no lives were lost. Nature's demolition of the Tacoma Narrows Bridge is given as a classic example of the destructive forces that can be induced in a structure that is subject to periodic influxes of energy. In this case, the energy was provided by the wind, which swept the bridge at the appropriate resonating frequency of the structure. With insufficient restraint, or damping, any vibrating structure may eventually be destroyed, as long as it is drawing energy from the source.

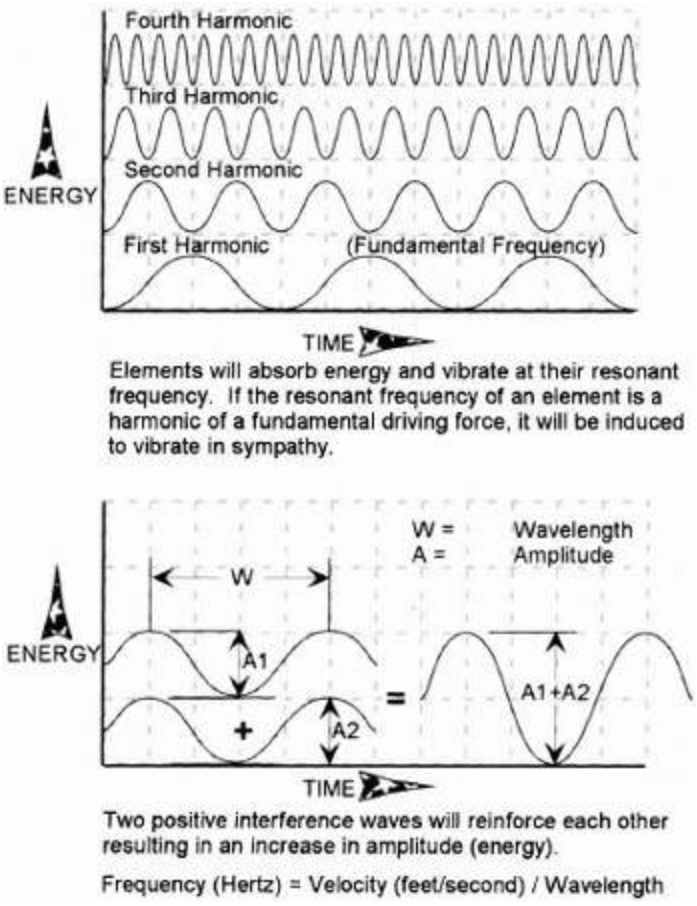

Fourth Harmonic
Third Harmonic
Second Harmonic
First Harmonic
(Fundamental Frequency)
ENERGY
TIME
Elements will absorb energy and vibrate at their resonant frequency. If the resonant frequency of an element is a harmonic of a fundamental driving force, it will be induced to vibrate in sympathy.
W = Wavelength
A = Amplitude
W
A1
A2
A1+A2
ENERGY
TIME
Two positive interference waves will reinforce each other resulting in an increase in amplitude (energy).
Frequency (Hertz) = Velocity (feet/second) / Wavelength

FIGURE 34. ***Resonance and Harmonics***

Another example of the potentially destructive force of resonance, and the measure taken to prevent it, is the instruction for soldiers to break step when marching across a bridge. Each step of an individual soldier acts as a force on the bridge. If the rest of the company joins this soldier in marching in unison across the bridge, the energy provided by that one step is amplified many times over, and the bridge will vibrate in time to the march. The pounding foot on the bridge is known as the forcing frequency. If the frequency of the marching feet happens to coincide with the natural frequency at which the bridge resonates, the absorption of energy will be maximized and the vibration of the bridge will become much greater, and it could potentially cause the bridge to collapse.

The *Encyclopedia Britannica* explains this phenomenon: "As has already been suggested, if the damping is very small, a vibrator will draw correspondingly large average power from the source, especially at resonance. If the damping becomes effectively zero, momentarily, or even

negative' as can happen under certain peculiar circumstances, the power withdrawal may become so great as to lead to a runaway vibration that may destroy the vibrator."[9]

At the Army Corp of Engineers Research Laboratory in Champaign, Illinois, there is a huge "shake table" that is used to test military equipment. The table can simulate the forces of an earthquake by generating both longitudinal and transverse waves. The vibration of the table can also be ramped up and down to any desired frequency. A demonstration of resonance using the shake table leaves one with a strong sense of the awesome power this unique phenomenon can unleash. To demonstrate the effect resonance can have on an object, the shake table is fitted with several long plastic tubes, around six inches in diameter and of various lengths. The tubes are clamped perpendicular to the tabletop. The table is then vibrated and slowly ramped up in frequency. The tubes slowly sway back and forth until the vibrations reach the resonant frequency of anyone tube, and then that tube begins to oscillate more than the others. If that frequency is maintained for a period of time, that tube shakes wildly while the other tubes remain relatively stable. Before the tube shakes loose from its clamp, the operator raises the frequency and the oscillations of the one tube die down. The frequency of the table continues to increase until another tube begins to vibrate wildly. The process repeats itself across each of the tubes on the table. At its own unique resonant frequency, each tube will draw more energy from the source.

It is clear, then, that in order to draw mechanical vibrations and relieve the stresses that build up within the Earth, we would need an object that would respond sympathetically with the Earth's fundamental frequency. This object would need to be designed in such a way that its own resonant frequency was the same as, or a harmonic of, the Earth's. In this manner, energy transfer from the source would be at maximum load. In harmony with the Earth's vibrations, this object would have the potential to become a coupled oscillator. (A coupled oscillator is an object that is in harmonic resonance with another, usually larger, vibrating object. When set into motion, the coupled oscillator will draw energy from the source and vibrate in sympathy as long as the source continues to vibrate.)

Because the Earth constantly generates a broad spectrum of vibration, we could utilize vibration as a source of energy if we developed suitable

technology. Naturally, any device that attracted greater amounts of this energy than is normally being radiated from the Earth would greatly improve the efficiency of the equipment. Because energy will inherently follow the path of least resistance, it follows that any device offering less resistance to this energy than the surrounding medium through which it passes would have a greater amount of energy channeled through it. Keeping all of this in mind and knowing that the Great Pyramid is a mathematical integer of the Earth, it may not be so outlandish to propose that the pyramid is capable of vibrating at a harmonic frequency of the Earth's fundamental frequency.

As it turns out, such is the case!

Acoustic data, scanty as it is, supports the theory that the Great Pyramid responds to vibrations from within the Earth. I wish I had been with NASA consultant and acoustic engineer Tom Danley when he conducted his acoustical analysis within the King's Chamber. I owe him a great deal because he performed a task that I have wanted to see transpire for twenty years. As of this writing, Danley is remaining very quiet about his research in Egypt because he is currently under a nondisclosure agreement with the Schor Foundation, a private research organization headed by industrialist Joseph Schor. The Schor Foundation funded Danley's research within the Great Pyramid in 1996 and, honoring an agreement with the Egyptian Department of Antiquities, they are keeping strict control of all the information they gathered there.

There was another member of this party, however, who is not keeping so quiet. Boris Said (pronounced Sa-eed) is a self-proclaimed documentarian and was a producer of *The Mysteries of the Sphinx* documentary. Said was under a nondisclosure agreement with Schor as well, but claims that Schor negated the agreement by not telling him that his permit to film at Giza had been withdrawn, or had expired, as he was still working on the plateau. In an interview on the Art Bell radio show, Said described Danley's experiments, which involved the use of large amplifiers, subwoofers, and accelerometers (an instrument designed to detect vibration) that were strategically placed in the King's Chamber and in each of the air spaces above the King's Chamber. Much of what Danley discovered remains with Danley, but what little Said has disclosed to promote a documentary video he produced is quite revealing:

Subsequent experiments conducted by Tom Danley in the King's Chamber of the Great Pyramid and in Chambers above the King's Chamber suggest that the pyramid was constructed with a sonic purpose. Danley identifies four resident[10]*frequencies, or notes, that are enhanced by the structure of the pyramid, and by the materials used in its construction. The notes from* [sic] *an F Sharp chord, which according to ancient Egyptian texts were the harmonic of our planet. Moreover, Danley's tests show that these frequencies are present in the King's Chamber even when no sounds are being produced. They are there in frequencies that range from 16 Hertz down to 1/2 Hertz, well below the range of human hearing. According to Danley, these vibrations are caused by the wind blowing across the ends of the so-called shafts—in the same way as sounds are created when one blows across the top of a bottle.*

Included in the program is a meeting with a Native American maker of sacred flutes from Oregon. His flutes, which are made to serenade Mother Earth, are tuned to the key of F Sharp![11]

Danley has come up with an interesting theory regarding the wind as the source of the infrasonic sound, but I wonder if he is really hiding something. Did his instruments reveal the source of the sound to be the Earth itself, but he is not allowed to tell? The reason I wonder is that fans have been installed within the mouths of the shafts Danley refers to; and in the west side of the passage leading into the King's Chamber is a tunnel bored to the northern shaft, which has been opened along its length for several feet, precluding any vibrations in the King's Chamber from being caused by the "Coke bottle" effect. Moreover, the fans were installed to *remove* excess heat and humidity, and are drawing air *from* the pyramid's chambers through the shafts to the outside. All of these are conditions that would make the "Coke bottle" effect extremely unlikely. Danley, as an acoustical engineer, must know this as well as I do. Therefore, I wonder if the most likely source for the infrasonic sound within the King's Chamber is the Earth itself.

I recently had the opportunity to confirm the acoustical phenomena of the King's Chamber in a unique and rather fortuitous way, although without Danley's instrumentation or expertise. On February 24, 1995, I paid the

inspector of the Giza Plateau $100 to leave me inside the Great Pyramid after all the tourists had left and it was officially closed. It was Ramadan, a sacred time for Muslims, and tourist attractions were closing early. I had asked to be left alone in the Great Pyramid for thirty minutes with all the lights turned off. Mohammed, the inspector, thought I was going to meditate, and I did not correct his thinking as I negotiated the deal. My backpack was weighted with my water bottle, an essential item in Egypt, and some instruments I had brought along specifically to take some acoustical and electromagnetic frequency measurements. I was pressed for time, and the activities I had planned allowed no time for meditation. I had asked for the lights to be turned off because I did not want any background electrical noise to affect the digital frequency counter with which I was equipped. I had brought this along to measure radio frequencies that I believe can be generated by the resonant chamber inside the Great Pyramid. I also had brought along a tape recorder, which I turned on and placed upon a block of granite situated close to the granite coffer (I will call the coffer a "box" from this point forward) in the King's Chamber. Using this block as a work stage, I positioned my flashlight, the digital frequency counter, and a monochromatic tuner, which measures sound frequency and is used to tune musical instruments, as I heard the last batch of tourists making their way down the Ascending Passage to the outside.

When the noise faded away, I began to test the frequency of the granite box. I had read in a booklet by flautist Paul Horn (that accompanied his album *Inside the Great Pyramid)* that the granite box resonated at a frequency of 438 cycles per second (Hz).[12] Horn had used a Korg tuner, which is quite a bit more expensive than the Matrix tuner I was using, to perform his own acoustical tests inside the chamber. I thumped the side of the box with my fist. The tuner registered between 439 and 440 Hz. I loudly hummed that note to test the resonance of the King's Chamber. Sliding up the scale, I noted that the reverberation faded until I produced the same note one octave higher, and then the reverberation was even greater. It was then time to test for radio frequencies, and the lights were still not turned off. I was becoming concerned because I had to be out of there in fifteen minutes, so I crouched back through the passageway, stood at the top of the Grand Gallery, and yelled to the guards to turn off the lights. While there, I intoned the note I

had hummed earlier, then scurried back into the King's Chamber with the intent of being by my flashlight before I was pitched into darkness. At last, the hum of the lights ended abruptly; I was left with only the light from my flashlight. My heart was pounding in my chest. I was sweating profusely. I had reached the moment of truth.

Not that day! To my chagrin, I realized that the hum of the lights was masking the whir of fans installed in the alleged "air channels." The guards had turned the lights off, but, as I discovered later, they could not turn off the fans without a key to the electrical box that controlled them. I "blessed" Rudolph Gantenbrink for such a fine engineering job, for he had installed those fans before he made his famous exploration of the Queen's Chamber shafts. Disappointed that I would not be able to use any data, I went ahead and took some readings anyway. I then packed my materials and hurried out of the King's Chamber, down the Grand Gallery, tortured my thighs again down the Ascending Passage, then walked quickly through Al Mamun's forced passage to the gate and out to fresh air.

Back in my hotel room, I rewound the tape, played it back, and discovered three very interesting acoustical phenomena. First, the tape had picked up overtones to the note I was humming in the King's Chamber. I had been unable to hear them while I was in the chamber because I was the source of the sound. This was a very exciting discovery, as it supported my theory on the King's Chamber. I tempered my enthusiasm, however, with the thought that it might be the equipment that was resonating at a higher frequency and generating this overtone. Mine was not a very expensive tape recorder, but still I believe the overtones were generated by the chamber complex itself (including the granite ceiling beams) because of the King's Chamber's true design and purpose. The second discovery revealed that when I was on the Great Step at the top of the Grand Gallery yelling to have the lights turned off and then humming the tone, the playback sounded as if I had never left the room. At that moment, except for a small passageway, there were thousands of tons of granite and limestone that separated me from the recorder, and my voice was being projected into a 28-foot-high and 157-foot-long expanse of space. The third revelation was that the footsteps and noises I made, while traversing the low passage to and from the Grand Gallery, reverberated in the King's Chamber and caused it to resonate at its natural frequency. This was

noted on the Matrix monochromatic tuner that was turned on as I played back the tape. My footsteps and noises were registering at approximately 440 Hz. I particularly noted that the fluctuations of the tuner during this section of the playback were not as great as those I had observed inside the King's Chamber when I was humming the frequency.

On June 8, 1997, I was discussing these phenomena with Stephen Mehler, the director of research for the Kinneman Foundation. In February 1997 after appearing with Mehler on a television panel discussion in Santa Barbara, California, I had sent him an abstract of my theory regarding the Great Pyramid. He told me about an acoustics engineer named Robert Vawter who had done some studio analysis of a tape recording that he (Mehler) had made inside the King's Chamber. As he related it to me, those results were the same as mine. I was given Vawter's phone number and promptly gave him a call. Vawter confirmed what Mehler told me. He said that he had digitally processed the tape provided by Mehler, and he was able to isolate harmonic overtones of the intoned frequency. Vawter claimed that the King's Chamber was designed specifically as a resonant chamber in which sound of specific frequencies would resonate. He said that every dimensional feature of the chamber he had studied indicated the manifestation and form of harmonic resonance. He was in the process of compiling data to support his statement and will be publishing his findings in the future.

While I was discussing with Mehler my experience inside the King's Chamber and the noise of the tourists as they were leaving the pyramid, he related a report by Howard-Vyse, who claimed that he was in the King's Chamber and was able to hear a conversation taking place in the Subterranean Pit. Vawter confirmed the speculation that this is because the entire interior passageway was designed to maximize the throughput of sound. This same phenomenon is well known at St. Paul's Cathedral in London. The Whispering Gallery has surprised many a visitor, who hears a voice and turns around to see who is speaking, only to find no one there. The gallery is circular, with walls made of hard material. The sound of a person speaking in a low voice on one side of the gallery will be reflected around the circular wall, just grazing the hard surface, and can be heard on the other side of the gallery. The angle of incidence ensures total reflection of the sound.

With this experimental evidence available, and with what can be

extrapolated from the dimensions and mass of the Great Pyramid, we have an object that fits the criteria established as necessary for an object to draw vibrations from the Earth. That object is the Great Pyramid of Giza! Here is the product of an ancient civilization empowered with the knowledge that as long as the moon continued to orbit the Earth, the special relationship that existed between the two assured the Egyptians of vast amounts of energy. The source of the energy is the Earth itself, in the form of seismic energy. The ancient Egyptians saw tremendous value in this form of energy and expended a considerable amount of effort to tap into it. The benefits they received may have been twofold: energy to fuel their civilization, and the ability to stabilize the Earth's crust by drawing off seismic energy over a period of time rather than allowing it to build up to destructive levels.

Covering a large land area, the Great Pyramid is, in fact, in harmonic resonance with the vibration of the Earth—a structure that could act as an acoustical horn for collecting, channeling, and/or focusing terrestrial vibration. We are led to consider, therefore, that energy associated with the pyramid shape is not drawn from the air or magically generated simply by the geometric form of a pyramid, but that *the pyramid acts as a receiver of energy from within the Earth itself.* It could be, also, that these infrasonic sound waves provide an explanation for the physical phenomena some people have felt when entering the Great Pyramid. The "pyramid energy" that has inspired countless numbers of people since the time of Napoleon may be the effects of infrasonic sound on the brain, which is said to resonate at around 6 hertz.

I experienced the phenomenon myself while in Egypt in 1986. After being inside the Great Pyramid for about an hour, I found myself in a rather uncomfortable situation. Sick and in immediate need of a bathroom, I really did not know if I was going to make it; but I rushed out of the King's Chamber, down the Grand Gallery and Ascending Passage, squeezing past tourists. Once outside I ran down the hill to the Mena House and headed straight for the bathroom. I made it just in time. The bathroom walls in the Mena House were constructed of Aswan granite. As I relaxed and closed my eyes, and without any external influence, the resonance of the King's Chamber filled my head. At the same time a pyramid shape began to glow in the center of my forehead. It was only after leaving the Mena House that this

sensation faded. It could be that this phenomenon is only felt at certain times, according to the seismic activities within the Earth. I have not experienced it since then, although I have been inside the Great Pyramid several times since.

While infrasonic vibrations at around 6 hertz may influence the brain and produce various effects in humans, it seems that there must be other types of energy, or other frequencies, to explain phenomena that were noted to have occurred at the Great Pyramid more than one hundred years ago. Sir William Siemens, an Anglo-German engineer, metallurgist, and inventor, experienced a strange energy phenomenon at the Great Pyramid when an Arab guide called his attention to the fact that, while standing on the summit of the pyramid with hands outstretched, he could hear a sharp ringing noise. Raising his index finger, Siemens felt a prickling sensation. Later on, while drinking out of a wine bottle he had brought along, he experienced a slight electric shock. Feeling that some further observations were in order, Siemens then wrapped a moistened newspaper around the bottle, converting it into a Leyden jar. After he held it above his head for a while, this improvised Leyden jar became charged with electricity to such an extent that sparks began to fly. Reportedly, Siemens' Arab guides were not too happy with their tourist's experiment and accused him of practicing witchcraft. Peter Tompkins wrote, "One of the guides tried to seize Siemens' companion, but Siemens lowered the bottle towards him and gave the Arab such a jolt that he was knocked senseless to the ground. Recovering, the guide scrambled to his feet and took off down the Pyramid, crying loudly."[13]

M. Bovis, a Frenchman, visited the Great Pyramid and on passing through the King's Chamber he spotted some dead cats and other animals in a garbage can. Bovis noted that these animals did not have the usual putrid odor that is normally associated with decaying flesh and he became intrigued with this discovery, for the animals appeared to be dehydrated or mummified. Curious to find what conditions were creating this phenomenon, Bovis intuitively gave his attention to the actual shape of the pyramid. Upon his return to France, he constructed his own small pyramid, using a three-foot base and maintaining the precise 51°51' angle of the Great Pyramid. To his delight, he found that he could duplicate the mummification process he had observed in the pyramid and, taking his experiments further, he found that fruits and vegetables could be preserved also.

The phenomenon Bovis noted may indicate the presence of ultrasonic radiation within the pyramid. His claims, and those of other proponents of pyramid energy, seem to correlate, at first glance, with some applications that have been found for ultrasonic sound:

- *The aging of fermented beverages.* It has been noted that wine tastes smoother after being treated with pyramid energy. A modern technique in speeding up the aging process in wine is to irradiate the wine with ultrasonic sound. Perhaps the smooth-tasting wine enjoyed by pyramid-energy enthusiasts was aged by the pyramid in much the same manner.
- *Medical therapy.* One of the most frequent claims for pyramid energy is the therapeutic effect it has on people who subject themselves to its influence. Ultrasonics has claimed clinical successes in treating arthritis, muscular rheumatism, and sciatica.
- *The effect on bacteria and other microorganisms.* Ultrasonic radiation of sufficient intensity may destroy bacteria and other microorganisms; and if the intensity is low, growth is stimulated.

Karl Drbal, a Czechoslovak radio technician, began experimenting with pyramids in the late 1940s. The experiments disclosed some interesting phenomena that prompted Drbal to apply for a patent. With his colleagues, Drbal discovered that the sharpness of a razor blade was maintained longer than normal when the blade was kept inside a pyramid structure. In 1949, he submitted his "Pharaohs Shaving Device" to the patent office, but the officers did not take the application seriously and turned it down. With this rejection, Drbal staunchly resolved to determine how the pyramid shape worked, and then to explain it to the world in physical terms.

Collaborating with Drbal to find answers to the pyramid question were some of the finest metallurgical experts in Europe. Dr. Carl Benedicks of Stockholm, Sweden, experimented on the effect water had on steel. His results showed that water reduced the steel's hardness by as much as twenty-two percent. Benedicks' tests on worn razor blades revealed that moisture in the microcavities diminished the sharpness of the blade, and to stop this deterioration, it was necessary to dispel the water dipole molecules from the blade's edge. Benedicks' findings were that the pyramid shape created a

resonance or vibratory field. The resonance caused dehydration of the water in the microcavities of the blade, thereby allowing the blade to retain its sharpness.[14]

Professors Born and Lertes of Germany demonstrated that the dipole molecules of water were affected by microwave energy inside are sonant cavity such as a pyramid and that microwaves of centimeter wavelength and their harmonics can generate an accelerated rotation of the dipole molecules, initiating the dehydration process.[15]

Assuming these reports are accurate, they are strong indications that the Great Pyramid conducts a broad range of vibrational frequencies through its mass. When I consider the mathematical comparison of the dimensions of the Great Pyramid with the dimensions of the Earth, I am led to conclude that this correspondence was no coincidence, but was in fact the expressed intention of the builders. If the dimensions of the Earth determine the wave characteristics of vibrations emanating from the core, then it would obviously be beneficial to incorporate these dimensions in a receiver of these vibrations. The receiver would respond harmonically to the influence of the vibrations and be in a state of resonance with them. The energy of the Earth is tremendous. The seismic disturbances around the globe (for instance, an estimated one million earthquakes occur annually) and the awesome power released by a volcanic eruption attest to the magnitude of this Earth energy. And these accumulated stresses are a constant factor in the Earth's evolution.

Energy is the basis of creating electricity that we can utilize, so how can we harness the power of an earthquake? Obviously, today, if that much energy were being drawn from the Earth through the Great Pyramid, tourists would not be parading through it every day. In order for the system to work, the pyramid would need to be mechanically coupled with the Earth and vibrating in sympathy with it. To do this, the system would need to be "primed"—we would need to initiate oscillation of the pyramid before we could tap into the Earth's oscillations. After the initial priming pulse, though, the pyramid would be coupled with the Earth and could draw off its energy. In effect, the Great Pyramid would feed into the Earth a little energy and receive an enormous amount out of it in return (see Figure 35).

How do we cause a mass of stone that weighs 5,273,834 tons to oscillate? It

would seem an impossible task. Yet there was a man in recent history who claimed he could do just that! Nikola Tesla, a physicist and inventor with more than six hundred patents to his credit—one of them being the AC generator—created a device he called an "earthquake machine." By applying vibration at the resonant frequency of a building, he claimed he could shake the building apart. In fact, it is reported that he had to turn his machine off before the building he was testing it in came down around him. The New York *World-Telegram* reported Tesla's comments from a news briefing at the hotel New Yorker on July 11, 1935:

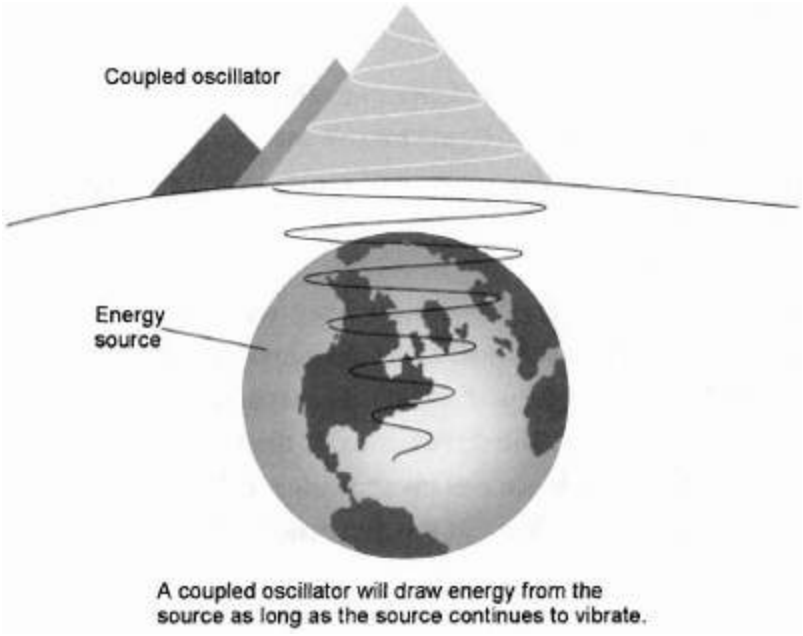

Coupled oscillator
Energy source
A coupled oscillator will draw energy from the source as long as the source continues to vibrate.

FIGURE 35. ***Coupled Oscillator***

I was experimenting with vibrations. I had one of my machines going and I wanted to see if I could get it in tune with the vibration of the building. I put it up notch after notch. There was a peculiar cracking sound.

I asked my assistants where did the sound come from. They did not know. I put the machine up a few more notches. There was a louder cracking sound. I knew I was approaching the vibration of the steel building. I pushed the machine a little higher.

Suddenly, all the heavy machinery in the place was flying around. I grabbed a hammer and broke the machine. The building would have been about our ears in another few minutes. Outside in the street there was

pandemonium. The police and ambulances arrived. I told my assistants to say nothing. We told the police it must have been an earthquake. That's all they ever knew about it.

A reporter at that point asked Dr. Tesla what he would need to destroy the Empire State Building. Tesla replied:

Five pounds of air pressure. If I attached the proper oscillating machine on a girder that is all the force I would need, five pounds. Vibration will do anything. It would only be necessary to step up the vibration of the machine to fit the natural vibration of the building and the building would come crashing down. That's why soldiers break step crossing a bridge.[16]

Scientist Tom Bearden, in a paper to the International Tesla Society in 1988, went further with Tesla's research into using the Earth as a source for energy and proposed that "all that need be done to extract enormous energy is to input the 'grid signal' into the Earth, and receive the enormous 'plate signal' response. The standing S-wave is continuously replenished from the stress energy in the earth itself, so power may be extracted continuously."[17] Bearden cautioned, however, that his model was based on an "idealized isotropic medium, and our results eventually must be modified to take into account the earth's anisotropy."[18]

By applying Tesla's technology in the Great Pyramid, using alternating timed pulses at the apex of the pyramid and in the Subterranean Chamber—a feature, by the way, that all the Egyptian pyramids have—we may be able set into motion 5,273,834 tons of stone! If we have trouble getting the Great Pyramid going, there are three small pyramids nearby that we can start first to get things moving. Once the vibration of the pyramid is coupled to the vibration of the Earth, the transfer of energy from the Earth to the pyramid could be sustained until the process is reversed. Once the pyramid is coupled to the Earth, we would have to design a system that would do something with the energy. I propose that the Egyptians had in fact created such a system, using crystals and other natural elements. The secrets of ancient technology may be beginning to emerge in a fantastic and extraordinary way. Let me

explain how.

Chapter Nine

THE MIGHTY CRYSTAL

Knowing that we can design an object to respond sympathetically with the Earth's vibration, how do we utilize that energy? How can we turn it into usable electricity? We must, first of all, understand what a transducer is. Earlier on we discussed the piezoelectric effect vibration has on quartz crystal (refer to Figure in chapter eight). Alternately compressing and releasing the quartz produces electricity. Microphones and other modern electronic devices work on this principle. Speak into a microphone and the sound of your voice (mechanical vibration) is converted into electrical impulses. The reverse happens with a speaker, where electrical impulses are converted into mechanical vibrations. As I mentioned, it also has been speculated that quartz-bearing rock creates the phenomenon known as ball lightning. It can do so because the quartz crystal serves as a transducer—it transforms one form of energy into another. When we understand the source of the energy and have the means to tap into it, all we need to do to convert the unlimited mechanical stresses therein into usable electricity is to utilize quartz crystals! As you might guess, the Great Pyramid contains quartz crystals, its own transducers.

Let me make no apology for the theory I am proposing. The Great Pyramid was a geomechanical power plant that responded sympathetically with the Earth's vibrations and converted that energy into electricity. They used the electricity to power their civilization, which included machine tools with which they shaped hard, igneous rock.

OK, you may say. Prove it! Just how does this power plant work? Well, let us start with the power crystals, or transducers. It so happens that the transducers for this power plant are an integral part of its construction and were designed to resonate in harmony with the pyramid itself and also with the Earth. The King's Chamber, in which a procession of visitors have noted

unusual energetic effects and in which Tom Danley detected infrasonic vibrations (which I postulated were coming from the Earth) is, in itself, a mighty transducer.

In any machine there are devices that function to make the machine work. This machine was no different. Although the inner chambers and passages of the Great Pyramid seem to be devoid of what we would consider to be mechanical or electrical devices, there are devices still housed there that are similar in nature to mechanical devices created today. These devices also could be considered to be electrical devices in that they have the ability to convert or transduce mechanical energy into electrical energy. We might think of other examples, as the evidence becomes more apparent. The devices, which have resided inside the Great Pyramid since it was built, have not been recognized for what they truly were. Nevertheless, they were an integral part of this machine's function.

The granite out of which the King's Chamber is constructed is an igneous rock containing silicon-quartz crystals. This particular granite, which was brought from the Aswan quarries, contains fifty-five percent or more quartz crystal. Dee Jay Nelson and David H. Coville saw special significance in the builders' choice of granite for constructing the King's Chamber. They wrote:

> *This means that lining the King's Chamber, for instance, are literally hundreds of tons of microscopic quartz particles. The particles are hexagonal, by-pyramidal or rhombohedral in shape. Rhomboid crystals are six-sided prisms with quadrangle sides that present a parallelogram on any of the six facets. This guarantees that embedded within the granite rock is a high percentage of quartz fragments whose surfaces, by the law of natural averages, are parallel on the upper and lower sides. Additionally, any slight plasticity of the granite aggregate would allow a "piezotension" upon these parallel surfaces and cause an electromotive flow. The great mass of stone above the pyramid chambers presses downward by gravitational force upon the granite walls thereby converting them into perpetual electric generators.*
>
> *The inner chambers of the Great Pyramid have been generating electrical energy since their construction 46 centuries ago. A man within the King's Chamber would thus come within a weak but definite induction*

field.[1]

While Nelson and Coville have made an interesting observation and speculation regarding the granite inside the pyramid, I am not sure that they are correct in stating that the pressure of thousands of tons of masonry would create an electromotive flow in the granite. The pressure on the quartz would need to be alternatively pressed and released in order for electricity to flow. The pressure they are describing would be static and, while it would undoubtedly squeeze the quartz to some degree, the electron flow would cease after the pressure came to rest. Quartz crystal does not create energy; it just converts one kind of energy into another. Needless to say, this point in itself leads to some interesting observations regarding the characteristics of the granite complex.

Above the King's Chamber are five rows of granite beams, making a total of forty-three beams weighing up to seventy tons each. The layers are separated by spaces large enough for the average person to crawl into. The red granite beams were cut square and parallel on three sides but were left seemingly untouched on the top surface, which is rough and uneven. Some of the beams even had holes gouged into their tops.

In cutting these giant monoliths, the builders evidently found it necessary to treat the beams destined for the uppermost chamber with the same respect as those intended for the ceiling directly above the King's Chamber. Each beam was cut flat and square on three sides, with the topside rough and seemingly untouched. Petrie wrote: "The roofing beams are not of 'polished granite,' as they have been described; on the contrary, they have rough-dressed surfaces, very fair and true so far as they go, but without any pretense to polish."[2] From his observations of the granite inside the King's Chamber, Petrie continued with those of the upper chambers: "All the chambers over the King's Chamber are floored with horizontal beams of granite, rough dressed on the under sides which form the ceilings, but wholly unwrought above."[3] These facts are interesting, considering that the beams directly above the King's Chamber would be the only ones visible to those entering the pyramid. Even so, the attention these granite ceiling beams received was nonetheless inferior to the attention commanded by the granite out of which the walls were constructed.

It is remarkable that the builders would exert the same amount of effort in finishing the thirty-four beams that would not be seen once the pyramid was built as they did the nine beams forming the ceiling of the King's Chamber, which would be seen. Even if these beams were imperative to the strength of the complex, deviations in accuracy would surely be allowed, making the cutting of the blocks less time consuming. Unless, of course, the builders were either using these upper beams for a specific purpose, or were using standardized machining methods that produced parts with little variation.

Traditional theory, proposed by Howard-Vyse and supported by Egyptologists, has it that the granite beams served to relieve pressure on the King's Chamber and allowed this chamber to be built with a flat ceiling. I disagree. The pyramid builders knew about and were already utilizing a design feature that was structurally sound on a lower level inside the pyramid. If we look at the cantilevered arched ceiling of the Queen's Chamber, we can see that it has more masonry piled on top of it than does the King's Chamber. The question could be asked, therefore, that if the builders had wanted to put a flat ceiling in this chamber, wouldn't they have needed to add only one layer of beams? For the distance between the walls, a single layer of beams in the Queen's Chamber, like the forty-three granite beams above the King's Chamber, would be supporting no more than their own weight (see Figure 36).

This leads me to ask, "Why does the King's Chamber need five layers of these beams?" From an architectural and engineering point of view, it is unnecessary to have so many monolithic blocks of granite in this structure. It is especially wasteful when we consider the amount of incredibly difficult work that must have been invested in quarrying, cutting, and transporting the stone from the Aswan quarries five hundred miles away—and then raising the beams to the 175-foot level of the pyramid. There is surely another reason for such an enormous effort and investment of time.

And look at the characteristics of these beams. Why cut them square and flat on three sides and leave them rough on the top? If no one is going to look at them, why not make them rough on all sides? Better still, why not make all sides flat? It would certainly make them easier to assemble. It is clear, then, that the forty-three giant beams above the King's Chamber were not included in the structure to relieve this chamber from excessive pressure from above,

but were included to fulfill a more advanced purpose. When we look at these beams with an engineer's eye, we can discern a simple, yet refined technology in this granite complex at the heart of the Great Pyramid, a technology that operated this power plant.

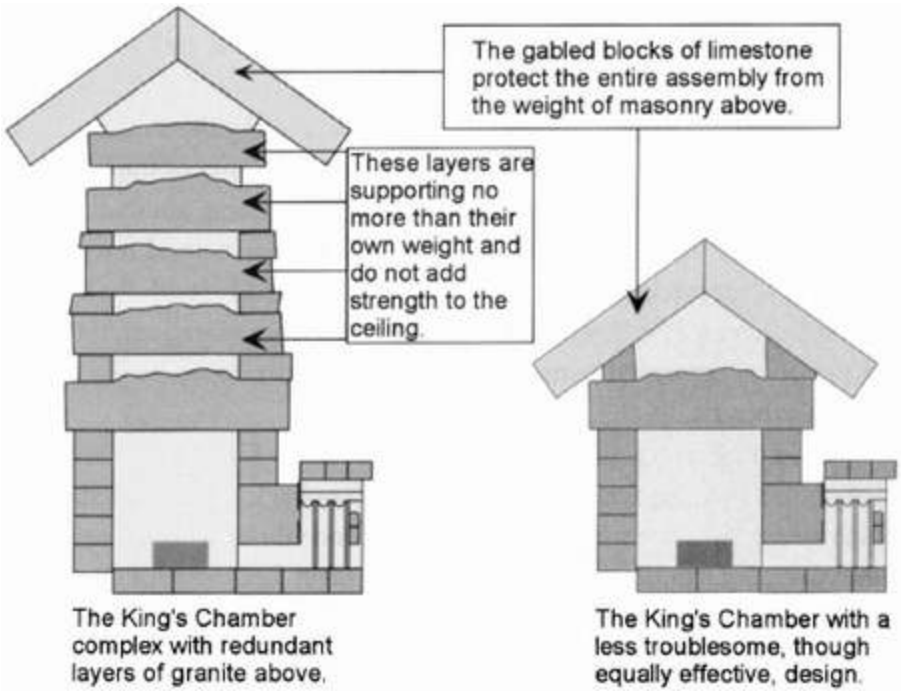

The gabled blocks of limestone protect the entire assembly from the weight of masonry above.
These layers are supporting no more than their own weight and do not add strength to the ceiling.
The King's Chamber complex with redundant layers of granite above.
The King's Chamber with a less troublesome, though equally effective, design.

FIGURE 36. ***Redundant Granite in King's Chamber Ceiling***

The giant granite beams above the King's Chamber could be considered to be forty-three individual bridges. Like the Tacoma Narrows Bridge, each one is capable of vibrating if a suitable type and amount of energy is introduced. If we were to concentrate on forcing just one of the beams to oscillate—with each of the other beams tuned to that frequency or its harmonic—the other beams would be forced to vibrate at the same frequency or a harmonic. If the energy contained within the forcing frequency was great enough, this transfer of energy from one beam to the next could affect the entire series of beams. A situation could exist, therefore, in which one individual beam, in the ceiling directly above the King's Chamber, could indirectly influence another beam in the uppermost chamber by forcing it to vibrate at the same frequency as the original forcing frequency or one of its harmonic frequencies. The amount of energy absorbed by these beams from the source would depend on the natural resonant frequency of the beam.

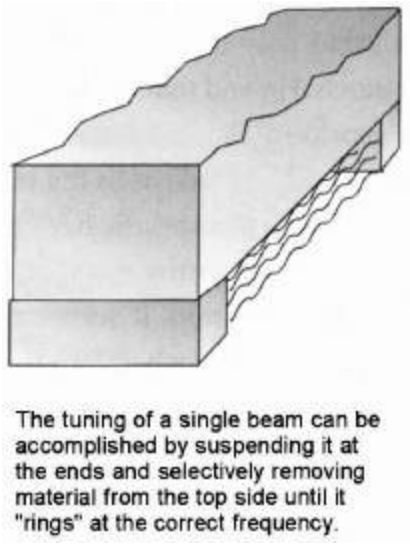
If this scenario is true, we have to consider the beams' ability to dissipate the energy they were subjected to, as well as their natural resonating frequency. If the forcing frequency (sound input) coincided with the beams' natural frequency (the beams were not restrained from vibrating), then the transfer of energy would be maximized. Consequently, so would the vibration of the beams.

We know that the giant granite beams above the King's Chamber have a length of seventeen feet (the width of the chamber), the entire length of which we assume can react to induced motion and vibrate without restraint. Some damping would occur if the beams' adjacent faces were so close that they rub together. However, if the beams vibrate in unison, it is possible that such damping would not happen. To perfect the ability of the forty-three granite beams to resonate with the forcing frequency, the natural frequency of each beam would have to be of the same frequency as the forcing frequency, or be in harmony with it.

It would be possible for us to tune a length of granite, such as those found in the Great Pyramid, by altering its physical dimensions. We could attain a precise frequency by either altering the length of the beam—as a guitarist alters the length of a guitar string—or by removing material from the beam's mass, as in the tuning of bells. (A bell is tuned to a fundamental hum and its harmonics by removing metal from critical areas.) If we would strike the beam, as one would strike a tuning fork, while it is being held in a position similar to that of the beams above the King's Chamber, we could induce oscillation of the beam. Then we could sample the frequency of the beam's vibration and remove more material until the correct frequency was reached.

Rather than suffering from a lack of attention, therefore, the rough top surfaces of those granite beams in the King's Chamber have been given more careful and deliberate attention and work than the beams' sides or bottoms. Before the ancient craftspeople placed them inside the Great Pyramid, each beam may have been "tested" or "tuned" by being suspended on each end in the same position that it would have once it was placed inside the pyramid (see Figure 37). The workers would then shape and gouge the topside of each beam in order to tune it before it was permanently positioned inside the pyramid. After cutting three sides square and true to each other, the remaining side could have been cut and shaped until it reached a specific

resonating frequency. The removal of material on the upper side of the beam would take into consideration the elasticity of the beam, as a variation of elasticity might result in more material being removed at one point along the beam's length than at another. The fact that the beams above the King's Chamber are all shapes and sizes would support this speculation. In some of the granite beams, I would not be surprised if we found holes gouged out of the granite as the tuners worked on trouble spots. What we find in the King's Chamber, then, are thousands of tons of granite that were precisely tuned to resonate in harmony with the fundamental frequency of the Earth and the pyramid!



The tuning of a single beam can be accomplished by suspending it at the ends and selectively removing material from the top side until it "rings" at the correct frequency.

FIGURE 37. ***Beam Tuning***

Smyth and Petrie unwittingly provided clues that this resonance theory not only may be plausible, but indeed may be probable. Both sought an explanation for the holes gouged near the ends of these granite beams. Smyth said, "These markings, moreover, have only been discovered in those dark holes or hollows, the so-called 'chambers: but much rather 'hollows of construction: broken into by Colonel Howard-Vyse above the 'King's Chamber' of the Great Pyramid. There, also, you see other traces of the steps of mere practical work, such as the 'bat-holes' in the stones, by which the heavy blocks were doubtless lifted to their places, and everything is left perfectly rough."[4] Rather than seeing them as holes used for lifting the blocks into place, Petrie speculated on an alternate reason for Smyth's so-called "bat-

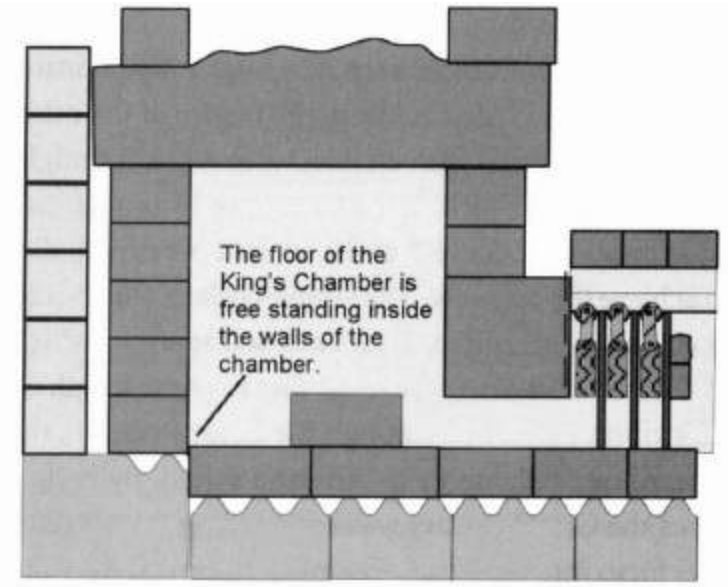
holes"; "The flooring of the top chamber has large holes in it, evidently to hold the butt ends of beams which supported the sloping roof-blocks during the building."[5]

Neither Smyth's nor Petrie's explanations are particularly satisfactory. The most likely and logical reason for the holes gouged near the end of the beam may have been to strategically weaken the beam in order for it to respond more readily to sound input. According to Boris Said, who was with engineer Tom Danley when he conducted his acoustical tests inside the King's Chamber, the King's Chamber's granite beams resonated at a fundamental frequency and the entire structure of the chamber reinforced this frequency by producing dominant frequencies that created an F-sharp chord. Not surprisingly, the F-sharp chord is believed to be in harmony with the Earth. While testing for frequency, Danley placed accelerometers in the spaces above the King's Chamber, but I do not know whether he went as far as checking the frequency of each beam. Said said something in his interview with Art Bell that may be some indication of where Danley was heading with his research: He said that the beams above the King's Chamber were "like baffles in a speaker." Further research would need to be conducted before any assertion could be made as to the relationship these holes may have with tuning these beams to a specific frequency. However, when we consider the characteristics of the entire granite complex, along with other features found in the Great Pyramid, it seems clear that the results of this research will be along the lines of what I am theorizing.

Without confirmation that the granite beams were carefully tuned to respond to a precise frequency, I will infer that such a condition exists in light of what is found in the area. While I have not found any specific record of anyone striking the beams above the King's Chamber and measuring their resonant frequencies, there has been quite a lot written about the resonating qualities of the coffer inside the chamber itself. The coffer is said to resonate at 438 hertz and is at resonance with the resonant frequency of the chamber. This is easily tested and has been noted by numerous visitors to the Great Pyramid, including myself.

Another interesting discovery was made by the Schor expedition. This is a preliminary report, told to Art Bell by Boris Said: It was discovered that the floor of the King's Chamber does not sit on solid rock. Not only is the entire

granite complex surrounded by massive limestone walls with a space between the granite and the limestone, the floor itself sits on what is characterized as "corrugated" rock (see Figure 38). Acoustical analysis of the floor of the King's Chamber (by Danley) revealed that the flooring blocks are not sitting on solid masonry. There are pockets beneath the floor that indicate that the support for the floor is "corrugated" like an egg carton, with the flooring sitting on nodes. In addition, the walls of the chamber do not sit on the granite floor, but are supported from the outside and sunk five inches below floor level. The entire complex is freestanding from the limestone masonry, has minimal damping of the floor, and is thus free to vibrate at peak efficiency. It is no wonder the entire chamber "rings" while tourists walk around inside!



What may lie beneath the floor of the King's Chamber

FIGURE 38. ***Floor of the King's Chamber***

The granite complex inside the Great Pyramid, therefore, is poised ready to convert vibrations from the Earth into electricity. What is lacking is a sufficient amount of energy to drive the beams and activate the piezoelectric properties within them. The ancients, though, had anticipated the need for more energy than what would be collected only within the King's Chamber. They had determined that they needed to tap into the vibrations of the Earth over a larger area inside the pyramid and deliver that energy to the power center—the King's Chamber—thereby substantially increasing the amplitude of the oscillations of the granite.

Modern concert halls are designed and built to interact with the instruments performing within. They are huge musical instruments in themselves. The Great Pyramid can be seen as a huge musical instrument with each element designed to enhance the performance of the other.

While modern research into architectural acoustics might focus predominantly upon minimizing the reverberation effects of sound in enclosed spaces, there is reason to believe that the ancient pyramid builders were attempting to achieve the opposite. The Grand Gallery, which is considered to be an architectural masterpiece, is an enclosed space in which resonators were installed in the slots along the ledge that runs the length of the gallery. As the Earth's vibration flowed through the Great Pyramid, the resonators converted the vibrational energy to airborne sound. By design, the angles and surfaces of the Grand Gallery walls and ceiling caused reflection of the sound, and its focus into the King's Chamber. Although the King's Chamber also was responding to the energy flowing through the pyramid, much of the energy would flow past it. The specific design and utility of the Grand Gallery was to transfer the energy flowing through a large area of the pyramid into the resonant King's Chamber. This sound was then focused into the granite resonating cavity at sufficient amplitude to drive the granite ceiling beams to oscillation. These beams, in turn, compelled the beams above them to resonate in harmonic sympathy. Thus, with the input of sound and the maximization of resonance, the entire granite complex, in effect, became a vibrating mass of energy.

Sound farfetched? Not if we realize that many isolated aspects of this

proposed phenomenon have been noted by visitors and researchers over the years. In particular, the acoustic qualities of the design of the upper chambers of the Great Pyramid have been referenced and confirmed by numerous visitors since the time of Napoleon, whose men discharged their pistols at the top of the Grand Gallery and noted that the explosion reverberated into the distance like rolling thunder. Strike the coffer inside the King's Chamber and you will hear a deep bell-like sound of incredible and eerie beauty. It has been a practice over the years for the Arab guides to demonstrate this resonating sound to the tourists they guide through the Great Pyramid. This sound was even included on Paul Horn's album, *Inside the Great Pyramid.* After being advised of the significant pitch produced by striking the coffer, and the chamber's response to this pitch, Horn took along a device that would allow him to replicate the exact pitch and frequency. Horn struck the coffer and tuned his flute to the tone that was emitted, which turned out to be the note A—which vibrates at 438 cycles per second. In a fascinating booklet about his experiment at the Great Pyramid, Horn described his experience in the inner chambers: "The moment had arrived. It was time to play my flute. I thought of Ben Peitcsh from Santa Rosa, California, and his suggestions to strike the coffer. I leaned over and hit the inside with the fleshy part of the side of my fist. A beautiful round tone was immediately produced. What a resonance! I remember him also saying when you hear that tone you will be (poised in history that is ever present.' I took the electronic tuning device I had brought along in one hand and struck the coffer again with the other and there it was—'A' 438, just as Ben predicted. I tuned up to this pitch and was ready to begin. [The album opens with these events so that you can hear all of these things for yourselves.]"[6]

And, indeed, the sound that Paul Horn brought into my living room was most fascinating. Listening to it, I could understand why so many people develop feelings of reverence when hearing it, for it has a most soothing effect on the nerves. For this alone, the album was worth the price. Horn himself described the effects this sound had on him: "Sitting on the floor in front of the coffer with the stereo mike in the centre of the room, I began to play, choosing the alto flute to begin with. The echo was wonderful, about eight seconds. The chamber responded to every note equally. I waited for the echo to decay and then played again. Groups of notes would suspend and all

come back as a chord. Sometimes certain notes would stick out more than others. It was always changing. I just listened and responded as if I were playing with another musician. I hadn't prepared anything specific to play. I was just opening myself to the moment and improvising. All of the music that evening was this way—totally improvised. Therefore, it is a true expression of the feelings that transpired."[7]

After noting the eerie qualities of the King's and Queen's Chambers, Horn went out onto the Great Step at the top of the Grand Gallery to continue his sound test. The Grand Gallery, he reported, sounded rather flat compared with the other chambers, but then he heard something remarkable: The music he was playing was coming back to him clearly and distinctly from the King's Chamber. The sound was going out into the Grand Gallery and was being reflected through the passageway and reverberating inside the King's Chamber!

Horn does not attempt to explain this acoustical phenomenon, but it is tied in with the phenomena noted inside the King's Chamber. It would follow, therefore, that the coffer inside the King's Chamber was specifically tuned to a precise frequency, and that the chamber itself was scientifically engineered to resonate in harmony with sound waves that were generated in the Grand Gallery and focused into it. Perhaps these observations will provide an answer to Horn's experience and to a mystery that Petrie puzzled over at great length. He discovered a flint pebble under the coffer, after he raised it, and instead of dismissing it as debris or otherwise, he mulled over its significance. He wrote:

> *The flint pebble that had been put under the coffer is important. If any person wished at present to prop the coffer up, there are multitudes of stone chips in the pyramid ready to hand. Therefore, fetching a pebble from the outside seems to show that the coffer was first lifted at a time when no breakages had been made in the pyramid, and there were no chips lying about. This suggests that there was some means of access to the upper chambers, which are always available by removing loose blocks without any forcing. If the stones at the top of the shaft leading from the subterranean part to the gallery had been cemented in place, they must have been smashed to break through them, or if there were*

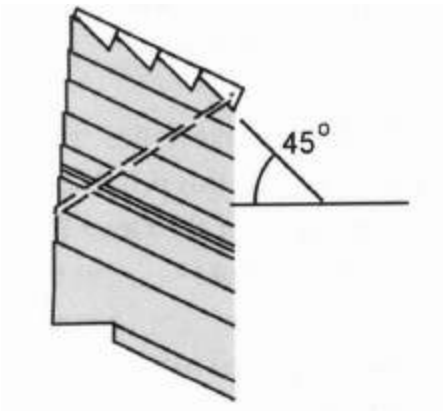
granite portcullises in the Antechamber, they must also have been destroyed; and it is not likely that any person would take the trouble to fetch a large flint pebble into the innermost part of the Pyramid, if there were stone chips lying in his path.[8]

If Petrie says that something is important, I tend to take notice of what he is talking about. Nonetheless, I am not convinced that this pebble could *not* have been brought into the King's Chamber long after the Great Pyramid was built and used to prop up the coffer so that it could be moved. On the other hand, Petrie does pose another alternative that deserves some speculation, and I cannot help wondering if it is possible that the pebble served a greater purpose for those who placed it there. If we had just manufactured an object like the coffer and had it tuned to vibrate at a precise frequency, we would know that to set it flat on the floor would dampen the vibrations somewhat. By raising one end of the coffer onto the pebble, however, it could vibrate at peak efficiency.

Another unique feature of the Grand Gallery, which needs to be confirmed by on-site inspection, is the approximate angle that is achieved by it having a ratchet-style ceiling. The problem with coming up with an accurate calculation of the true angle of the overlapping stones in this ceiling is that there is conflicting data from the only two researchers I have found who pay these overlaps any close attention. However, preliminary calculations are interesting to say the least. According to Smyth, the angle of the Grand Gallery is 26°17'37", the height of the Grand Gallery is between 333.9 inches and 346.0 inches, and he counted thirty-six overlaps in the 1,844.5-inchlength of the ceiling.[9] Writing about his observations and measurements of the tilting tiles, Smyth said, ". . . when I was actually pushing up the point of a long measuring rod, against the roof stones, differences were found to so great an extent as 12.1 inches, which I did attribute chiefly to that very cause [that the tiles did indeed tilt] ."[10] With the overlaps estimated to have approximately a twelve-inch tilt, the surface of the overlapping stones in the ceiling yields an amazing approximation to a 45-degree angle from a vertical plane (135 degrees polar coordinates, given that the ends of the gallery are 90 degrees). With this tilt of the roof tiles, a sound wave traveling vertically to the roof would be reflected off the tiles at a 90-degree angle and would travel

in the direction of the King's Chamber (see Figure 39).

This gives pertinence to another report, which did not receive much attention at the time it was made. It has been reported that Al Mamun's men had to break a false floor out of the Grand Gallery, and as they broke one stone out, another slid down in its place. This is a sketchy bit of information that would require further research, if further research is possible, because Al Mamun's men were tearing out so much limestone that little attention was given to this incident. However, what if that stone slid because the tiled floor in this gallery had a rachet style that matched the style of its ceiling? Much of the stone that Al Mamun cut out of the Ascending Passage was dropped down the Descending Passage. Later explorers, such as Caviglia, Davison, and Petrie, eventually cleared this passage of all debris, and most of this debris was dumped on the traditional rubbish pit on the north and east sides of the Great Pyramid. Petrie reported finding inside the Great Pyramid a prism-shaped stone that had a half-round groove running its length. In the Descending Passage he found a block of granite that was 20.6-inches thick with a tube-drilled hole cut through the thickness on one edge. Where this granite came from and what purpose it was used for in the Great Pyramid was a mystery to Petrie, who wrote, "What part of the Pyramid this can have come from is a puzzle; nothing like it, and no place for it, is known."[11] With more significant findings attracting researchers' attention, though, it is not surprising these details were not given much consideration.



The ceiling tiles in the Grand Gallery tilt, resulting in an angle of approximately 45 degrees.

FIGURE 39. ***Roof Tiles of the Grand Gallery***

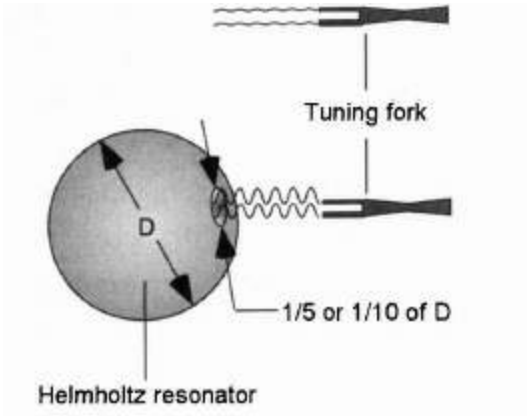
It has been assumed that the rachet-style ceiling in the Grand Gallery was so designed to prevent an accumulation of forces bearing down the angle of the gallery and pressing on the lower pieces. Yet other angled passages in the Great Pyramid, such as the Ascending and Descending Passages, have flat ceilings, so I am left to conclude that this feature was, indeed, specifically designed for an acoustical purpose.

Even if some of the masonry clues are now lost to us, it may be possible for an acoustical engineer to confirm that the Grand Gallery indeed reflected sound in the manner proposed by examining only its dimensions and angles. Perhaps this book will encourage an engineer to create a computer model of the Grand Gallery and perform an analysis by simulating the movement of sound within the cavity. Though I have attempted to find some means to accomplish this, I have not been able to find anybody with access to a supercomputer who is willing to do the work, and the software needed to perform the analysis has not, to my knowledge, been published for a microcomputer yet.

We can also extrapolate other information about acoustical devices that are obviously no longer in place within the Grand Gallery. Knowing that the King's Chamber will respond to sound of a specific frequency, thereby transducing that energy into electrical energy, I theorized earlier that the Grand Gallery housed resonators that converted the coupled Earth/pyramid vibration to airborne sound. The existence of resonators in this gallery is predicted by what has been found inside the King's Chamber and the design of, and phenomena noted in, the Grand Gallery. The mystery of the twenty-seven pairs of slots in the side ramps is logically explained if we theorize that each pair of slots contained a resonator assembly and the slots served to lock these assemblies into place. The original design of the resonators will always be open to question; however, if their function was to efficiently respond to the Earth's vibration, then we can surmise that they might be similar to a device we know of today that has a similar function—a Helmholtz resonator.

A Helmholtz resonator responds to vibrations and actually maximizes the transfer of energy from the source of the vibrations. The resonator is normally made out of metal, but it can be ma4e out of other materials. A classic example of a Helmholtz resonator is a hollow sphere with a round opening that is 1/10 to 1/5 the diameter of the sphere. The size of the sphere

determines the frequency at which it will resonate. If the resonant frequency of the resonator is in harmony with a vibrating source, such as a tuning fork, it will draw energy from the fork and resonate at greater amplitude than the fork is able to without its presence. It forces the fork to greater energy output than what is normal, or "loads" the fork. Unless the energy in the fork is replenished, its energy will be exhausted quicker than it normally would be without the Helmholtz resonator. But as long as the source continues to vibrate, the resonator will continue to draw energy from it at a greater rate (see Figure 40).[12]



By virtue of its design, the Helmholtz resonator, over time, draws more energy from a vibrating source, such as a tuning fork, than what the source will give up naturally.

FIGURE 40. ***Helmholtz Resonator***

To extrapolate further we could say that each resonator assembly that was installed in the Grand Gallery was equipped with several Helmholtz-type resonators that were tuned to different harmonic frequencies. In a series of harmonic steps, each resonator in the series responded at a higher frequency than the previous one. In a manner similar to the King's Chamber's response to energy inputs—its creation of an F-sharp chord—these resonators raised the frequency of the vibrations coming from the Earth. To increase the resonators' frequency, the ancient scientists would have made the dimensions smaller, and correspondingly reduced the distance between the two walls adjacent to each resonator. In fact, the walls of the Grand Gallery actually step inward seven times in their height and most probably the resonators' supports reached almost to the ceiling. At their base, the resonators were

anchored in the ramp slots. Not surprisingly, there is additional evidence in the Grand Gallery to support this premise, especially in a design feature of the gallery that is seldom given much thought. This is a groove, or slot, cut along the length of the second layer of the corbelled wall. This groove suggests the resonators were held in place inside the Grand Gallery and positioned, or keyed, into the structure by first being installed into the ramp slots and then held in a vertical position with "shot" pins in the groove. Once the resonator assemblies were positioned and locked into place, the angle of the slot effectively prevented them from moving (see Figure 41). The vertical supports for the Egyptian resonators were most likely made of wood because it is one of the most efficient responders to vibration; and, as we will discuss in chapter twelve, their disappearance from the pyramid can be easily explained. In crafting the resonators out of wood, the ancient Egyptians made a natural and logical choice, as the wood probably emitted a humming sound itself.

Prior to my visit to Egypt in 1986, I had speculated that the slots along the Grand Gallery floor anchored wooden resonators, but that these devices were balanced in a vertical orientation reaching almost to the full height of the gallery. If this speculation were true, it would logically follow that the geometry of the twenty-seven pairs of slots would provide proof. The bottom of the slots might have been parallel to the horizontal plane rather than parallel with the angle of the gallery, and the side walls of the slots might have been vertical to a horizontal plane rather than perpendicular to the angle of the gallery. This was a significant detail and a simple one to check out.

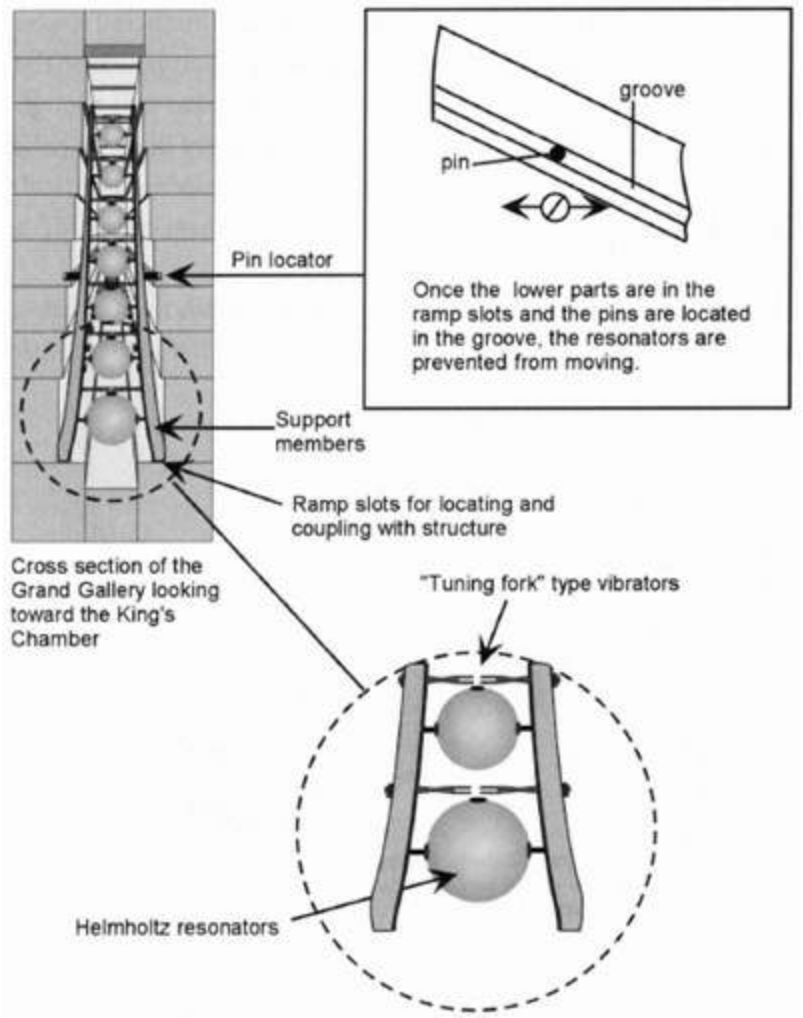

groove
pin
Pin locator
Once the lower parts are in the ramp slots and the pins are located in the groove, the resonators are prevented from moving.
Support members
Ramp slots for locating and coupling with structure
Cross section of the Grand Gallery looking toward the King's Chamber
"Tuning fork" type vibrators
Helmholtz resonators

FIGURE 41. ***Design and Installation ofthe Resonators***

My first trek inside the Great Pyramid in 1986 did not reveal anything about the geometry of these slots because they were filled with dirt and debris. The following day I set out with a soup spoon that I had "borrowed" from the hotel restaurant. Digging out the dirt and debris, with tourists and guides looking at me like I was crazy (actually, it was probably illegal to do this as you need special permission to carry out excavations in Egypt), I finally came to the bottom of one slot and it was as I predicted it would be: parallel to the horizontal, and the sides of the slot perpendicular to the horizontal. Other slots were perpendicular to the horizontal as well, though some of them had bottoms that were parallel with the gallery floor. In either scenario, it appears that the slots were prepared to accommodate a vertical structure, rather than to restrain weight that would exert shear pressure from

the side (see Figure 42).

In attempting to determine the design and materials the resonators were made of, we must consider evidence from artifacts that are not inside the pyramid but are housed within the Cairo Museum, where the most remarkable feats of machining in the world can be found. In the museum's collection are stone jars and bowls so finely machined and perfectly balanced that they inspire awe and wonder. One bowl in particular, a schist bowl with three lobes folded toward the center hub, is an incredible piece of work. If the artisans used ultrasonics and sophisticated machinery, I can understand how it could have been made; but even if they used those methods, the purpose for creating such a complex piece, for what is assumed to have been a domestic purpose, has long escaped me (see Figure 43). Other vases with small necks that open into a wide round belly on the inside have confounded other researchers, such as Graham Hancock, who wrote, "During my travels in Egypt I had examined many stone vessels—dating back in some cases to pre-dynastic times—that had been mysteriously hollowed out of a range of materials such as diorite, basalt, quartz crystal and metamorphic schist. For example, more than 30,000 such vessels had been found in the chambers beneath the Third Dynasty Step Pyramid of Zoser at Saqqara. That meant that they were at least as old as Zoser himself (i.e. around 2650 BC)."[13]

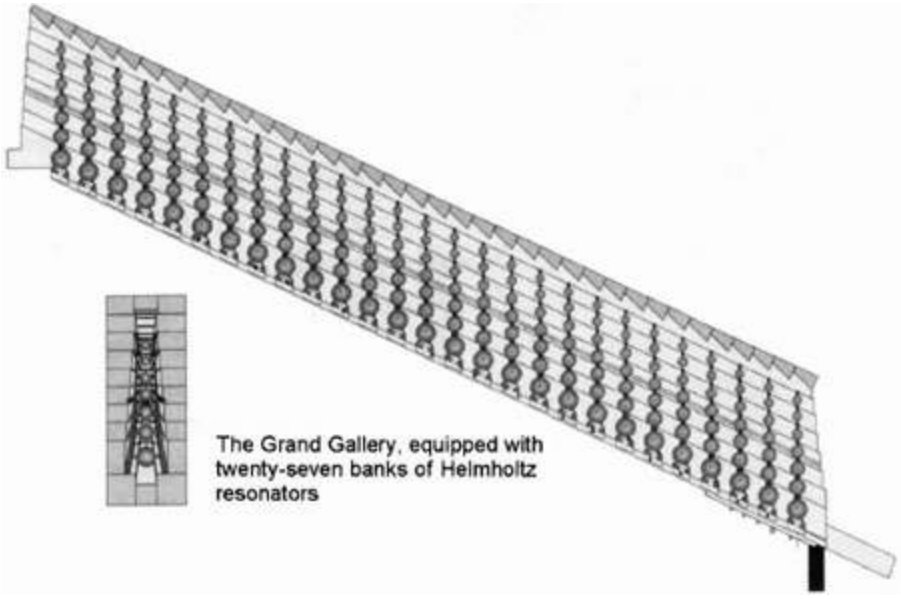


FIGURE 42. ***Grand Gallery Resonators***

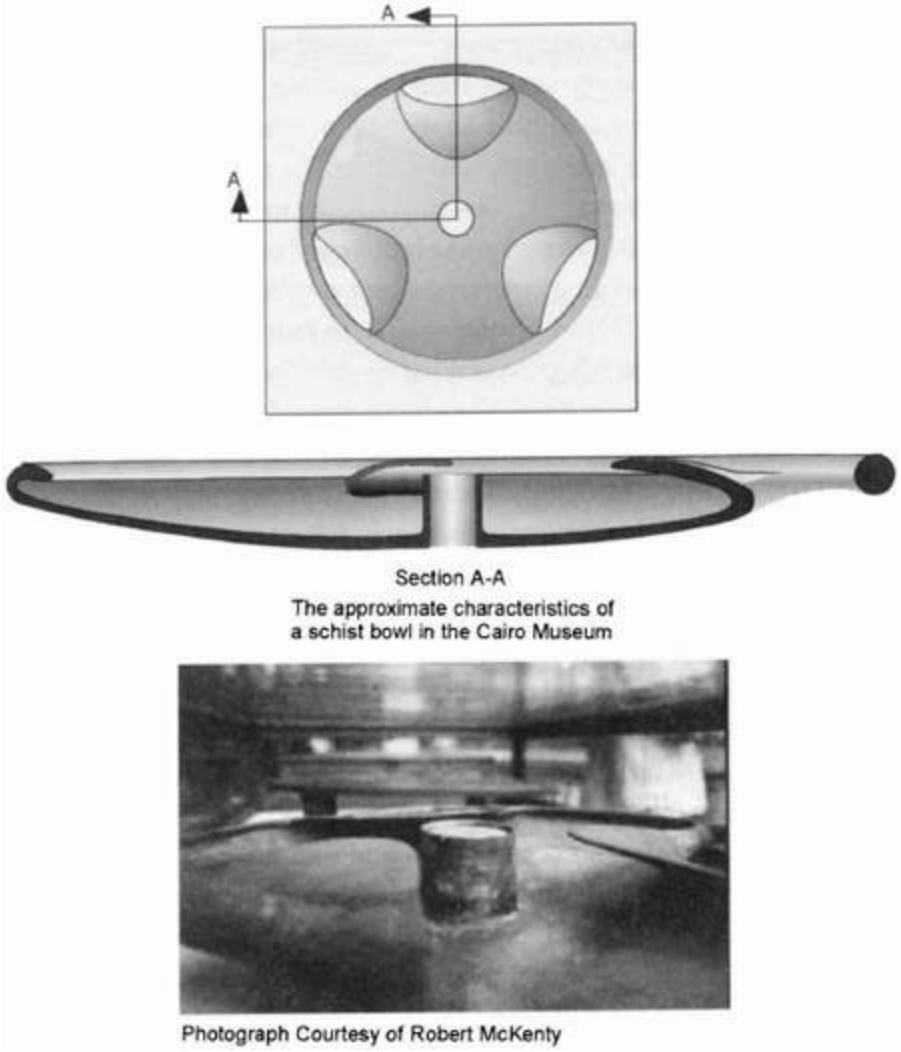


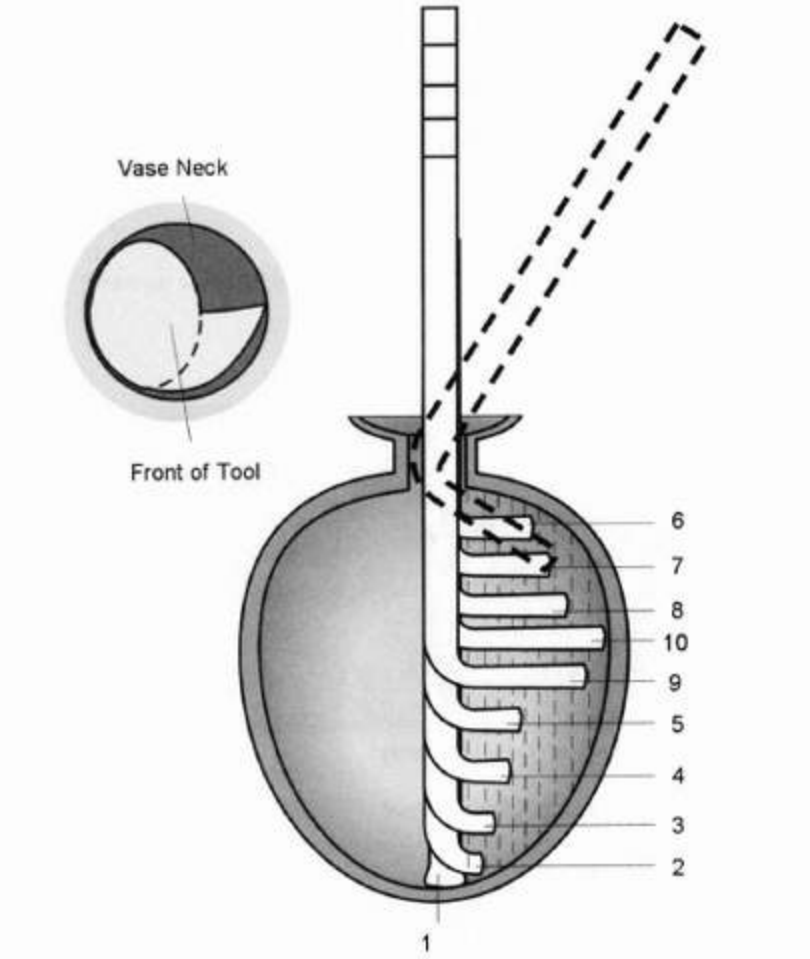
FIGURE 43. ***Schist Bowl***

Regardless of the age of these artifacts, the technical accomplishment of the artisans who created the vases and bowls does not support the notion that they worked with primitive tools. I am in full agreement with Hancock, who pondered on an unimaginable technology and said, "Why unimaginable? Because many of the vessels were tall vases with long, thin, elegant necks and widely flared interiors, often incorporating fully hollowed-out shoulders. No instrument yet invented was capable of carving vases into shapes like these, because such an instrument would have had to have been narrow enough to have passed through the necks and strong enough (and of the right shape) to have scoured out the shoulders and the rounded interiors. And how could sufficient upward and outward pressure have been generated and

applied within the vases to achieve these effects?"[14]

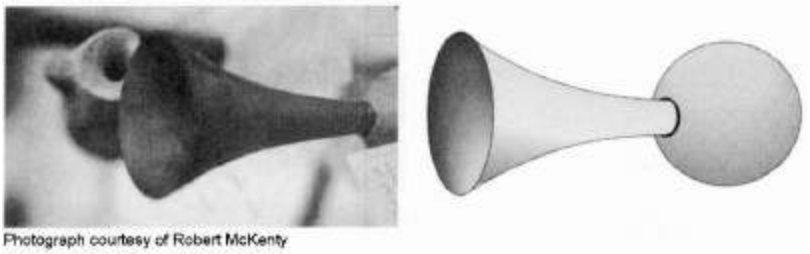
The questions Hancock posed are legitimate. As a machinist, I have created smaller products with similar geometry, for the aerospace industry. The technique I used to hollow out these modern stainless steel artifacts on a lathe involved drilling a hole and then using a series of L-shaped tools. After the first L-shaped tool had been used to open up the "chamber" bore, I held each successive tool in my hand and "snaked" the L through the neck into the piece before clamping the tool in the tool-holder. Once it was firmly clamped, I had to make sure that it was positioned correctly within the piece before the lathe began to rotate. It was a tricky operation that required the use of a small mirror and a powerful light to see inside the workpiece (see Figure 44).

The work I performed in steel was easy compared to the granite, diorite, basalt, and metamorphic schist that were cut by the ancient Egyptians. I was extremely puzzled and could not undertand why they went to such trouble to create vases in this manner. We certainly do not go to this trouble to create vases today. Their purpose was obviously very important to have required such an effort. It then occurred to me that perhaps these stone artifacts were not domestic vases at all, but were used in some other way. Perhaps they were being used to convert vibration into airborne sound. Given their shape and dimensions—and the fact that there were 30,000 of them found in chambers underneath the Step Pyramid—are these vessels the Helmholtz resonators we are looking for? As if to provide us with clues, one of the bowls in the Cairo Museum has a horn attached to it, and one of the bowls does not have handles normally seen on a domestic vase, or urn, but has trunnion-like appendages machined on each side of it. These trunnions would be needed to hold the bowl securely in a resonator assembly (see Figures 45 and 46).



Tool numbers 1 through 10 are used in succession to hollow out the inside of a vase, such as the one illustrated. The dotted lines show the amount of material removed by one tool before another tool is needed. Ultrasonic assisted machining may have been employed in removing the material, as it would be difficult, if not impossible, for the tool to transfer adequate conventional machining forces from the tool holder to the cutting edge. Removing tool marks from the inside of the vase could be accomplished by using a slurry of small abrasive rock and water--similar to what lapidaries use today--and by rotating the bowl on its outside surface.

FIGURE 44. ***Machining a Swan-neck Vase***



Photograph courtesy of Robert McKenty

Is this fine stonework in the Cairo Museum actually a Helmholtz resonator?

FIGURE 45. ***Vessel with Horn Attached***

Photographs courtesy of Robert McKenty

FIGURE 46. ***Precision Machined and Balanced Bowl***

Heading back to the Great Pyramid, we find more evidence for our theory. The enigmatic Antechamber has been the subject of much consternation and discussion. Ludwig Borchardt, director of the German Institute in Cairo (circa 1925), proposed that a series of stone slabs were slid into place after Khufu had been entombed. He theorized that the half-round grooves in the granite wainscoting supported wooden beams that served as windlasses to lower the blocks (see Figure 47).

Borchardt may not have been far off with his analysis of the mechanism that was contained within the Antechamber. After building the resonators and installing them inside the Grand Gallery, the ancient Egyptians would have wanted to focus a sound of specific frequency, that is, a pure or harmonic chord, into the King's Chamber. They would be assured of doing so if they installed an acoustic filter between the Grand Gallery and the King's Chamber. By installing baffles inside the Antechamber, sound waves traveling from the Grand Gallery through the passageway into the King's Chamber would be filtered as they passed through, allowing only a single frequency or harmonic of that frequency to enter the resonant chamber. Those sound waves with a wavelength that did not coincide with the dimensions between the baffles would be filtered out, thereby ensuring that no interference sound waves could enter the resonant King's Chamber to reduce the output of the system (see Figure 48).

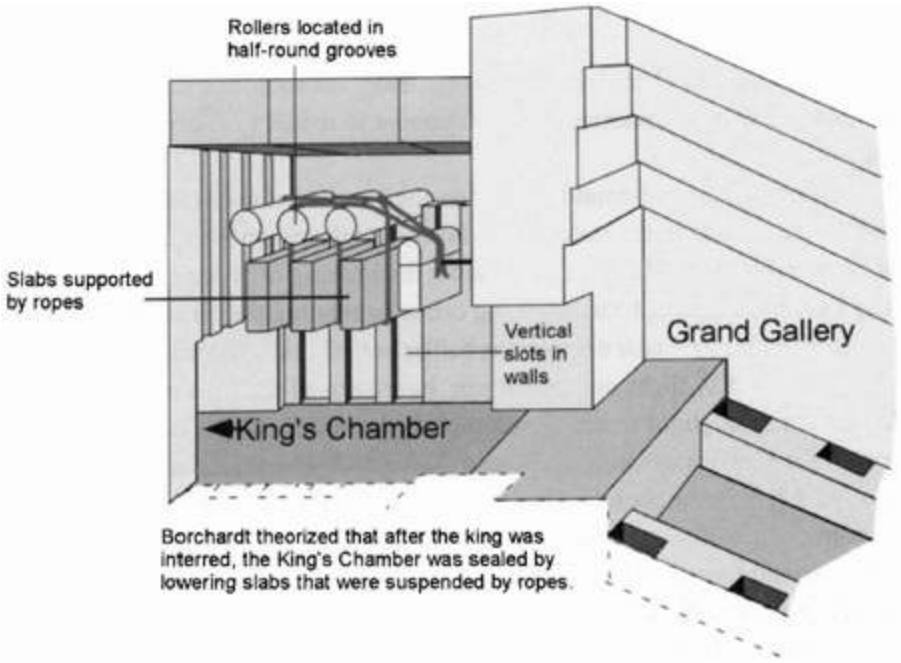


FIGURE 47. ***Borchardt's Theory***

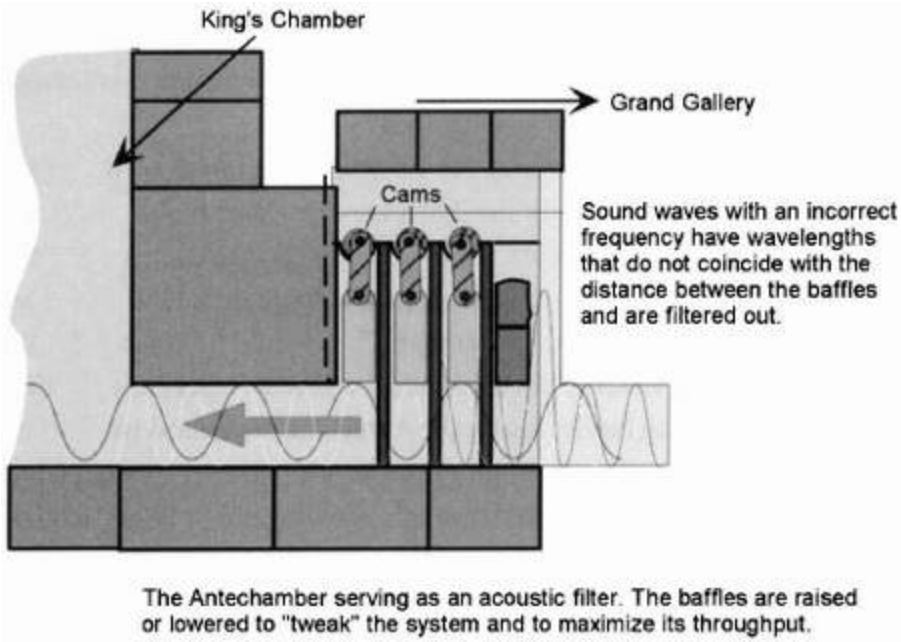

King's Chamber
Grand Gallery
Cams
Sound waves with an incorrect
frequency have wavelengths
that do not coincide with the
distance between the baffles
and are filtered out.
The Antechamber serving as an acoustic filter. The baffles are raised
or lowered to "tweak" the system and to maximize its throughput.

FIGURE 48. ***Acoustic Filter***

To explain the half-round grooves on the west side of the Antechamber and the flat surface on the east, we could speculate that when the installation of these baffles took place, they received a final tuning or "tweaking." This may have been accomplished by using cams. By rotating the cams, the off-

centered shaft would raise or lower the baffles until the throughput of sound was maximized. A slight movement may have been all that was necessary. Maximum throughput would be accomplished when the ceiling of the first part of the passageway (from the Grand Gallery), the ceiling of the passageway leading from the acoustic filter to the resonant King's Chamber, and the bottom surface of each baffle were in alignment. The shaft suspending the baffles would have then been locked into place in a pillar block located on the flat surface of the wainscoting on the opposite wall.

During my conversations with Stephen Mehler and acoustical engineer Robert Vawter, I discussed my theory of the Antechamber. Vawter confirmed my analysis that it was used as an acoustic filter and agreed that further studies are needed to quantify the exact physics employed, via "back engineering" the dimensions of the King's Chamber complex.

So, what if my theory is correct and the Great Pyramid was a resonance chamber power plant? The next questions would be how the Egyptians controlled the vibrations to avoid an overload or destructive wave like that which downed the Tacoma Narrows Bridge. Because a vibrating system can eventually destroy itself if there is no means to draw off or dampen the energy, the ancient Egyptians would have had to find some way to control the level of energy at which the system operated. Because the output of the resonant cavity would draw off the energy only up to a certain level—that being the maximum amount the granite complex could process—there would have to be some means of controlling the energy as it built up inside the Grand Gallery.

Normally there are three ways to prevent a vibrating system from running out of control. First, you can shut off the source of vibration. Obviously if the source of the vibration in the Great Pyramid was the Earth itself, the ancient Egyptians could not do this. Second, you can reverse the process that couples the resonator to its source. Third, you can contrive a means to keep the vibrations at a safe level. Because the Great Pyramid's source of vibration was the Earth, options two and three are the obvious choices to solve the problem. We will address number three because, in order for the power plant to continue to function, there must be a constant supply of energy. There are two ways to control a constant vibration. One is to dampen it and the other is to counteract it with an interference wave that cancels out the vibration.

Physically dampening the vibration would be impractical, considering the function of the Great Pyramid as a machine. The dampening would not always be necessary, unlike the dampening needs of a bridge, and indeed would have an adverse effect on the efficiency of the machine. It most probably would also involve building moving parts, like dampeners in a piano. Faced with these considerations, I looked more closely at the possibility that the ancient Egyptians may have cancelled out excess vibrations by using an out-of-phase interference sound wave. My inquiry began with the Ascending Passage, for it is the only feature inside the Great Pyramid that contains "devices" that are directly accessible from the outside. If the operators of the machine found it necessary to cancel out vibrations, they would have to be able to quickly respond to this need from the machine's exterior. I call the granite plugs inside this passage "devices" for the same reason I call the granite beams above the King's Chamber devices—for they are over-designed and over-crafted for their supposed use (see Figure 49). In the case of the Ascending Passage, it was not necessary to use granite to block this passage if the ancient Egyptians wanted to keep tomb robbers out—limestone would have been sufficient. Realistically, limestone would have been better. The very fact that the stones "blocking" this passage are granite contradicts their effectiveness at securing the inner chambers from robbers, which is the orthodox interpretation for their use. In fact, they had the opposite effect, drawing Al Mamun's attention to the existence of the Ascending Passage and, subsequently, to the entire internal arrangement of passages and chambers. No, these granite plugs had to have another reason for being there!

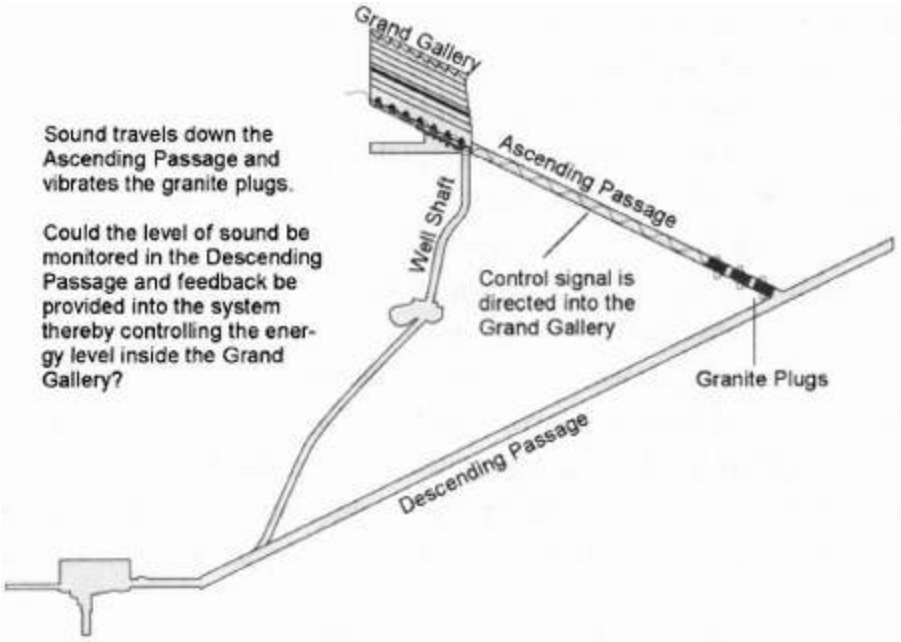

Grand Gallery
Sound travels down the Ascending Passage and vibrates the granite plugs.
Could the level of sound be monitored in the Descending Passage and feedback be provided into the system thereby controlling the energy level inside the Grand Gallery?
Ascending Passage
Well Shaft
Control signal is directed into the Grand Gallery
Granite Plugs
Descending Passage

FIGURE 49. ***Granite Plugs***

As I studied them, and envisioned their use, I realized that they may have been built into the structure to perform two critical roles. One would be to provide feedback to the power plant operators by responding to the sound that was generated inside the Grand Gallery and traveling down the Ascending Passage. The operators of this machine could have attached vibration sensors—much like the accelerometers that Danley used—to the bottom granite plug that is accessible from the Descending Passage, and thereby had the ability to monitor the energy level inside the Grand Gallery. The other task these granite plugs may have performed could have been to respond to vibration from equipment in the Descending Passage and transmit out-of-phase interference sound waves into the Ascending Passage and Grand Gallery to prevent vibrations within from reaching destructive levels. These functions explain not only the builders' reasons for selecting granite instead of limestone for these blocks but also the means by which the ancient Egyptians controlled the energy level of the system. We also could speculate that by directing a signal of the correct frequency up the Ascending Passage, the Egyptians may have been able to prime the system. In other words, the entire system would be forced to vibrate, and once in motion, it would draw energy from the Earth with no further input.

When Petrie examined these blocks, he noted that the adjoining faces of the

blocks were not flat but had a wavy finish ± .3 inches. He wrote:

> *These plug-blocks are cut out of boulder stones of red granite, and have not the faces cut sufficiently to remove the rounded outer surfaces at the corners: also the faces next to each other are never very flat, being wavy about plus or minus .300 inch. These particulars I was able to see, by putting my head in between the rounded edges of the 2nd and 3rd blocks from the top, which are not in contact; the 2nd having jammed tight 4 inches above the 3rd. The present top one is not the original end; it is roughly broken, and there is a bit of granite still cemented to the floor some way farther south of it. From appearances there I estimate that originally the plug was 24 inches beyond its present end.*[15]

I was unable to confirm this when I was in Egypt because the blocks exposed by Al Mamun's tunnel had slipped since Petrie's day and are now resting against each other. (An interesting aside about Petrie's observations is that they fully dismiss and put to rest orthodox theories regarding the granite plugs being slid down the Ascending Passage. Some granite, in Petrie's words, was "still cemented to the floor. . . ." This is indisputable proof that the granite plugs were positioned as the Great Pyramid was being built.) However, Petrie's observation makes for interesting speculation within the context of my theory. Were the faces of the blocks cut specifically to modify sound waves? Could the Ascending Passage serve to direct an interference out-of-phase sound wave into the Grand Gallery, thereby controlling the level of energy in the system? As I sought to answer these questions, more mysteries about the Great Pyramid revealed themselves—and began to yield to the possible answers provided by my theory.

Chapter Ten

AN AMAZING MASER

The elements of this power system that we have discussed so far are the crystal transducers contained within the King's Chamber granite, the chamber's tuned harmonic characteristics with the Earth, the acoustical properties of the Grand Gallery, and the design features (acoustic filters) of the Antechamber. How each of these elements fit together, with each reinforcing the other, becomes more significant as other elements of this energy system are brought to bear.

Obviously the above features are not all that are needed to make this system work. After transducing mechanical energy into electrical energy, there has to be a medium through which the electricity can flow and be utilized. In a modern power plant, steam passes across turbine blades causing rotation of a generator that stimulates electron flow through copper wires. In *this* power plant the vibrations from the Earth cause oscillations of the granite within the King's Chamber, and this vibrating mass of igneous, quartz-bearing rock influences the gaseous medium contained within the chamber. Currently this gaseous medium is air, but when this power plant operated, it was most likely hydrogen gas that filled the inner chambers of the Great Pyramid. The Queen's Chamber holds evidence that it was used to produce hydrogen, and we will look at this evidence in the next chapter. But first, we must look at the evidence for the technology that utilized this gas.

To maximize the output of the system, the atoms comprising this gaseous medium contained within the chamber should have a unique characteristic—the gas's natural frequency should resonate in harmony with the entire system. To be more accurate, the resonance of the chamber, which can be adjusted, should resonate in harmony with the frequency of hydrogen, which does not change. Under these conditions, the hydrogen atoms would more efficiently absorb the energy generated within the chamber. Atomic hydrogen

is the simplest atom, with one proton and one electron, and is responsible for the emission of microwave energy in the universe. This microwave background radiation is left over from the Big Bang and was first observed in 1965 by Arno Penzias and Robert Wilson at the Bell Telephone Laboratories in Murray Hill, New Jersey. The radiation has virtually the same energy or temperature in all directions in the sky. If we look up at the night sky, we can see many bright regions with clusters of stars and bright planets piercing the black backdrop of the universe. The cosmic microwave background temperature, however, varies very little across the sky. This signal from the Big Bang is constant and has been bombarding the Earth since it first began to form.[1] It is this signal from the universe that is an integral element in making the Giza power plant work. In order to understand how this could be, we need to understand how a maser works.

MASER is an acronym for Microwave Amplification through Stimulated Emission Radiation. The maser was developed before the laser—another acronym, meaning Light Amplification through Stimulated Emission Radiation—which, when it was first developed, was called an optical maser. So let us take a brief look at how lasers and masers operate.

To understand how a maser works, it would be best to describe something we can all see—light. Most of the light we are familiar with is incoherent light. The light that fills our homes from a fluorescent tube after the flip of a switch is the result of an electrical discharge energizing the atoms in a gaseous medium and pumping the electrons into a higher orbit around the proton. The electrons cannot be sustained at this higher energy level indefinitely, and will eventually fall back to their original position, or "ground state," releasing a packet of electromagnetic energy in the process. This packet of energy is called a photon. These photons are what we see as light, and the properties of the photons, with respect to wavelength and frequency, depend on the atoms in the gas. We recognize these properties by the color of the light. With fluorescent, the emission of photons is random and the photons travel in unpredictable directions (see Figure 50). The number of photons that are constantly being emitted is large enough that they will travel every conceivable direction possible, thereby illuminating a room.

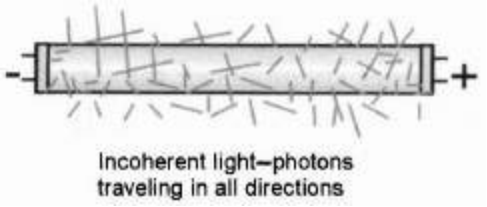


FIGURE 50. ***The Fluorescent Light***

The uniqueness of the laser is based on the assumption that while photons in a light tube will travel in every direction, one of those directions will be along the length of the tube, parallel to its axis. If we place mirrors at both ends of the tube, therefore, and align these mirrors perfectly parallel with each other, the photons will reflect off the mirrors, back along the same axis they are traveling.

This is where the "stimulated emission" part of the laser comes in to play. A photon traveling back along its axis will encounter an atom with an electron in a higher energy state. The photon collides with the electron and forces it down to a lower energy state, which stimulates the release of another photon. Now there are two photons traveling together along the axis of the tube to the mirror at the other end. The train of two photons then becomes four photons, then eight, and so on (see Figure 51). With photons traveling at 186,282 miles per second, across a relatively short distance, the built up laser energy is almost instantaneous.[2]

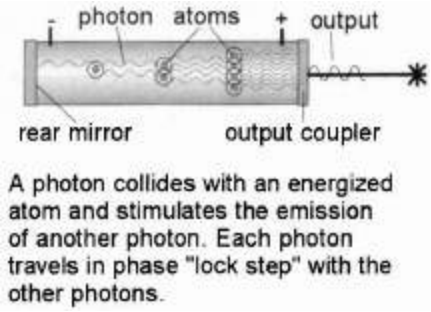

-
photon
atoms
+
output
rear mirror
output coupler
A photon collides with an energized atom and stimulates the emission of another photon. Each photon travels in phase "lock step" with the other photons.

FIGURE 51. ***Principles of a LASER***

A laser, however, is subject to the same runaway vibrations that we discussed earlier, as in the Tacoma Narrows Bridge disaster. The laser cavity is a resonator, and there has to be some release of the energy or the resonator will be destroyed. To accomplish this release, one mirror is coated with a material that allows a percentage of the laser energy to be transmitted through

the substrate, while the remainder is fed back into the cavity to sustain the "lasing" action.

The light beam that is emitted from a laser is coherent, collimated (does not spread like the light from a flashlight), and monochromatic. In other words, light of single frequency, or color, passes through the end mirror in a tight pencil beam. Light travels in waves, and the waves of the laser beam are of the same wavelength, and are in phase, or "lock stepped" with each other. This is the "amplification" part of the laser. Because the beam is coherent and collimated, the light cannot be seen until it strikes an object, such as a presentation screen, or as smoke in the air.

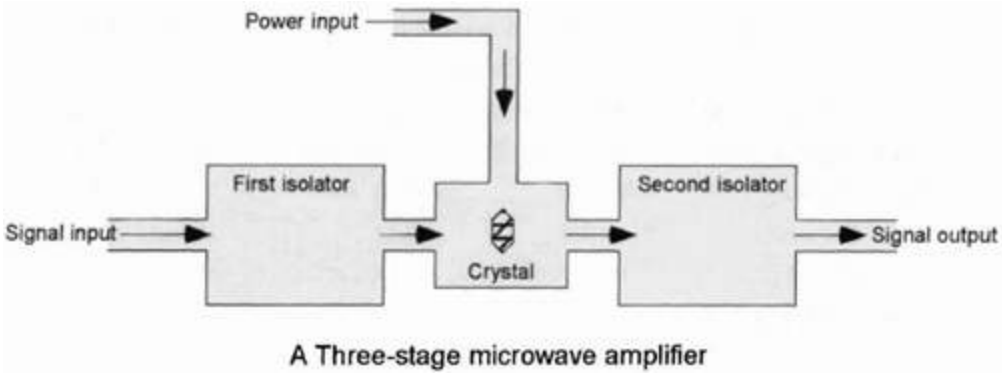


FIGURE 52. ***Microwave Amplifier***

We know that a lightbulb is incoherent light energy, and, similarly, we can point to a microwave oven as an example of incoherent microwave energy. The maser operates a little differently from the laser in that its photons are in a different part of the electromagnetic spectrum—nevertheless, its principle of operation is similar. There are many different designs and iterations of designs for both lasers and masers (see Figure 52). In the Great Pyramid, there is evidence that strongly indicates that the ancient Egyptian engineers and designers knew about and utilized the principles of a maser to collect the energy that was being drawn through the pyramid from the Earth and deliver it to the outside. This evidence can be found in the King's Chamber.

A power plant could be described as a large engine. As with any other kind of engine, fuel is fed into it and is converted into energy. This energy can then be converted to other forms of energy—such as mechanical or electrical energy—that is then drawn off and used in whatever way is suitable. The key to converting or transducing hydrogen gas to usable power in the Giza power

system was the introduction of acoustical vibration of the correct frequency and amplitude. (The amplitude is the amount of energy contained within a sound wave.) Based on the previous evidence, sound must have been focused into the King's Chamber to force oscillations of the granite, creating in effect a vibrating mass of thousands of tons of granite. The frequencies inside this chamber, then, would rise above the low frequency of the Earth—through a scale of harmonic steps—to a level that would excite the hydrogen gas to higher energy levels. The King's Chamber is a technical wonder. It is where Earth's mechanical energy was converted, or transduced, into usable power. It is a resonant cavity in which sound was focused. Sound roaring through the passageway at the resonant frequency of this chamber—or its harmonic—at sufficient amplitude would drive these granite beams to vibrate in resonance. Sound waves not of the correct frequency would be filtered in the acoustic filter, more commonly known as the Antechamber (see Figure 53).

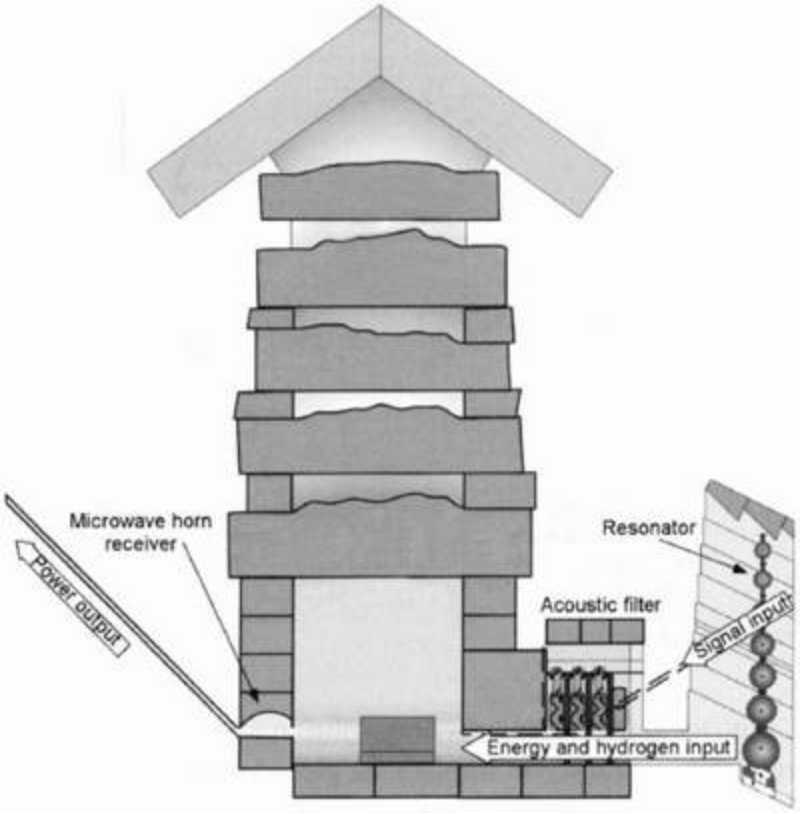


FIGURE 53. ***The Power Center***

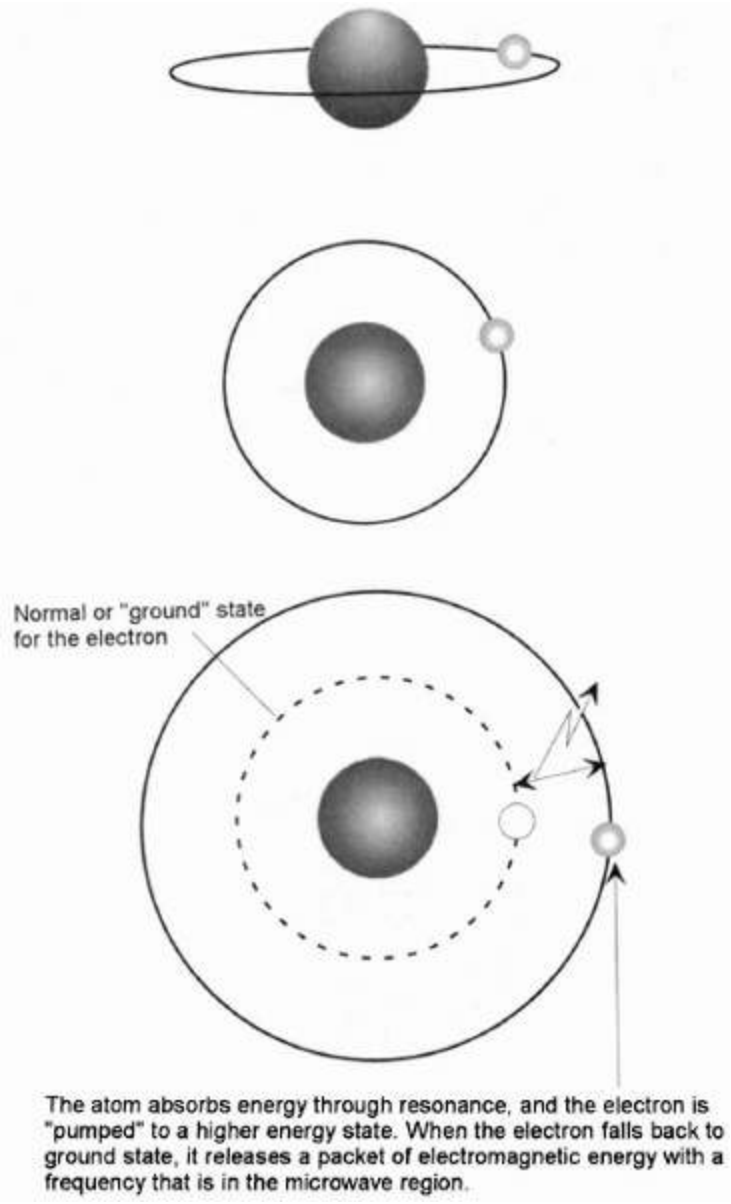

Normal or "ground" state
for the electron
The atom absorbs energy through resonance, and the electron is "pumped" to a higher energy state. When the electron falls back to ground state, it releases a packet of electromagnetic energy with a frequency that is in the microwave region.

FIGURE 54. ***Hydrogen***

With the granite beams vibrating at their resonant frequency, the sound energy would be converted through the piezoelectric effect of the silicon-quartz crystals embedded in the granite, creating high-frequency radio waves. Ultrasonic radiation would also be generated by this assembly. The hydrogen generated in the Queen's Chamber, directly below the King's Chamber, would fill the upper chambers and then efficiently absorb this energy as each atom responded in resonance to its input.

Hydrogen, as I explained, is the simplest atom, having only one electron

and one proton. The electron is "pumped" with energy to a higher energy level. In other words, the electron is induced to increase its distance from the proton. This is an unnatural state for the electron to be in, and in time it will fall back to its "ground state;' releasing a packet of energy as it falls (see Figure 54). The electron can be stimulated to fall back to ground state through the action of an input signal—another packet of energy—that is of the same frequency. The result is that the input signal continues its path after stimulating emission from the hydrogen atom and carries the energy released by the electron with it.

In the Giza power plant, the Northern Shaft served as a waveguide through which the input microwave signal traveled. A typical waveguide is rectangular in shape, with its width being the wavelength of microwave energy and its height measuring approximately one-half its width. The Northern Shaft waveguide was constructed precisely to pass through the masonry from the north face of the pyramid and into the King's Chamber. That microwave signal could have been collected off the outer surface of the Great Pyramid and directed into the waveguide (see Figure 55).

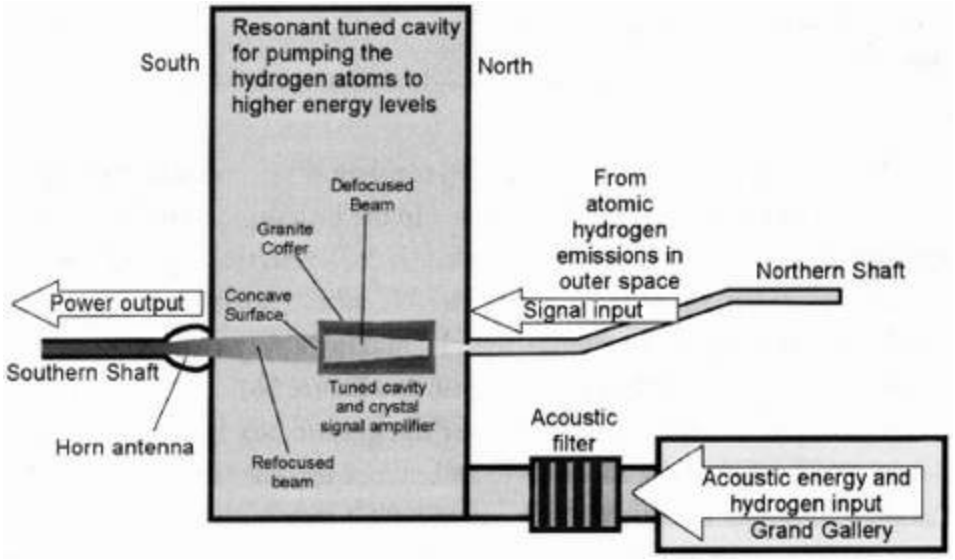


FIGURE 55. ***The Pyramid MASER***

The (originally smooth) surfaces on the outside of the Great Pyramid are "dish-shaped" and may have been treated to serve as a collector of radio waves in the microwave region that are constantly bombarding the Earth from the universe. Amazingly, this waveguide leading to the chamber has

dimensions that closely approximate the wavelength ofmicrowaveenergy—1,420,405,751.786 hertz (cycles per second). This is the frequency of energy emitted by atomic hydrogen in the universe. These features and facts are gathered in Table 3.

TABLE 3		
DESCRIPTION	MEASURE	UNIT
Frequency of atomic hydrogen (hf)[3]	1,420,405,751.786	hertz
Speed of electromagnetic radiation (light) per second (c)	186,282	miles
	11,802,827,520	inches
Wavelength of hydrogen microwave energy (c ÷ h)	8.309	inches
Width of Northern Shaft leading to King's Chamber[4]	8.4	inches
Height of Northern Shaft leading to King's Chamber[5]	4.8	inches

These features inexorably move us to consider the purpose for the goldplated iron that was discovered embedded in the limestone near the Southern Shaft. In order to have an efficient conduit for electromagnetic radiation, the entire lengths of the Northern and Southern Shafts would have to have been lined with this material, thereby making a very efficient conduit for the input signal and the power output (see Figure 56).

I have puzzled for a long time over the granite box inside the King's Chamber. This box, now located at the back of the chamber, is a critical component in this maser, and to imagine how it may have been used I am compelled to move it from its current position and place it between the waveguides in the north and south walls. There is evidence that leads me to suggest that it occupied this position and served to amplify the microwave signal that entered the resonant cavity. To understand how the granite box may have functioned, it would help to understand the basic principles of how optics function. Normally we associate optics with visible light. Most of us are familiar with telescopes, binoculars, and spectacles, and—with the exception of mirrors—naturally assume that we should be able to see through them. But that is not always the case. The material from which an optic is made depends on the wavelength of electromagnetic radiation that passes through it. As humans, we are equipped to see electromagnetic radiation (light) that lies in what we call the visible spectrum. There is light, however,

below and above the visible spectrum that we are not physically equipped to see. If we were, we would be able to see through some of the opaque materials that allow these wavelengths to pass freely.

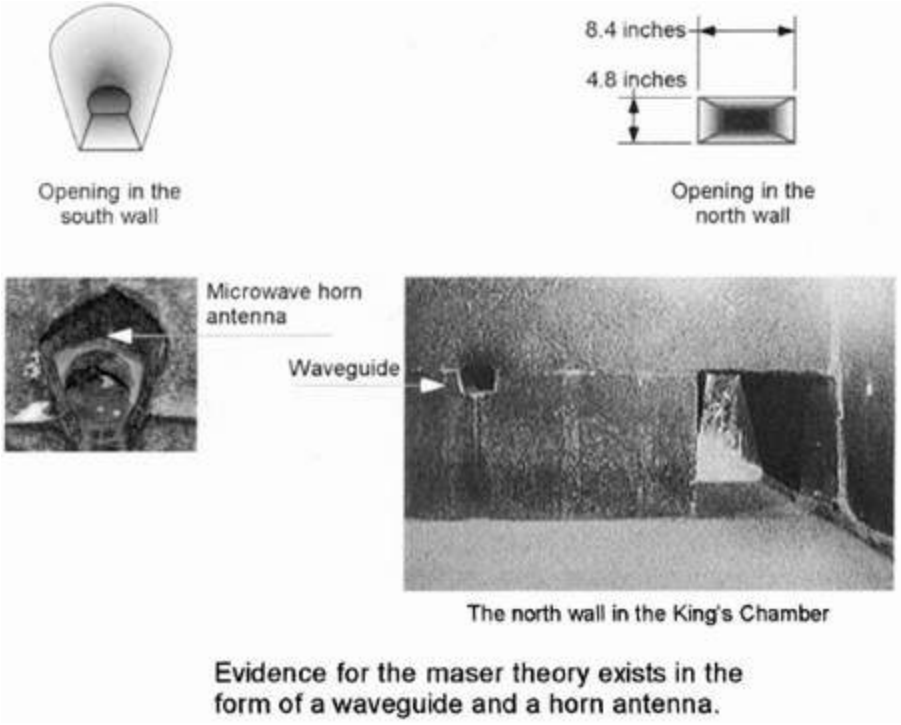

8.4 inches
4.8 inches
Opening in the south wall
Opening in the north wall
Microwave horn antenna
Waveguide
The north wall in the King's Chamber
Evidence for the maser theory exists in the form of a waveguide and a horn antenna.

FIGURE 56. ***Microwave Horn Antenna and Waveguide***

For example, the wavelength of a Nd.YAG (Neodymium.Yttrium-Arsenate-Garnet) laser is 1.06 microns. Optical components that pass light of this frequency also pass visible light. A CO_2 laser, on the other hand, has a wavelength that is 10.6 microns—ten times greater than a Nd.YAG—and the most efficient and cheapest material for passing CO_2 laser light is gallium arsenide, which humans like you and I cannot see through. If we want an example of a material that is opaque and yet passes electromagnetic radiation, we have to look only as far as the kitchen cabinets for the containers that we place in the microwave oven. Microwaves pass through an opaque dish and heat the food it contains. The granite coffer, densely opaque to us, would allow electromagnetic radiation, invisible to us, to pass through.

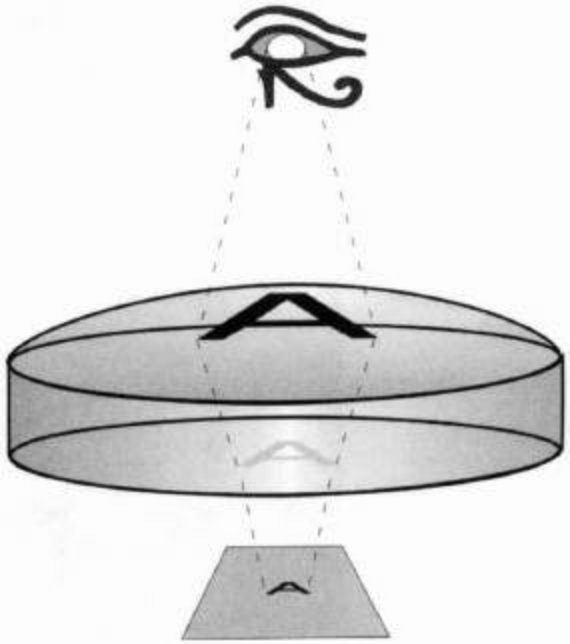


FIGURE 57. ***Refraction***

Having a material present that allows microwave energy to pass through, we can apply the basic principles of optics that affect all wave phenomena, including electromagnetic radiation. These principles are reflection and refraction. Reflection, of course, is a look in the mirror. Refraction explains the focusing of a lens, such as a magnifying glass (see Figure 57). For instance, lenses are ground with a curvature that refracts light in such a way that it is either focused or diverged, depending on the application. Eyeglasses are ground so that they focus the light rays that pass through them, bringing objects into clearer view.

There is evidence to suggest that the granite box could refract electromagnetic radiation as it passed through the box's north and south walls. Though fully accurate measurements for optical characteristics have not been made on these surfaces, Smyth's measurements show that the grinding on these surfaces produced a concave surface.[6] Manufactured in such a manner, the coffer—positioned in the path of the incoming signal through the Northern Shaft and with oscillating crystals adding energy to the microwave beam—may have served to spread or diverge the signal inside the box as it passed through the first wall. Within the confines of the granite box, the spreading beam would then interact and stimulate the emission of energy from the energized, or "pumped," hydrogen atoms (see Figure 58).

If we follow a straight line across the King's Chamber from where the Northern Shaft enters, we find a feature cut into the granite wall that closely resembles a horn antenna, much like a microwave receiver. Passing through the opposite wall of the coffer, then, the radiation picked up more energy, was once more refracted, and then focused into this horn antenna. The mouth of this opening shows signs of being severely damaged. Because of the curved geometry of this opening, somebody in the distant past probably found it necessary to hack away some of the granite in order to retrieve the gold or gold-plated metal lining. Nevertheless, what is left unmistakably identifies this feature as the receiver of microwave energy that entered the chamber from the waveguide in the north wall.

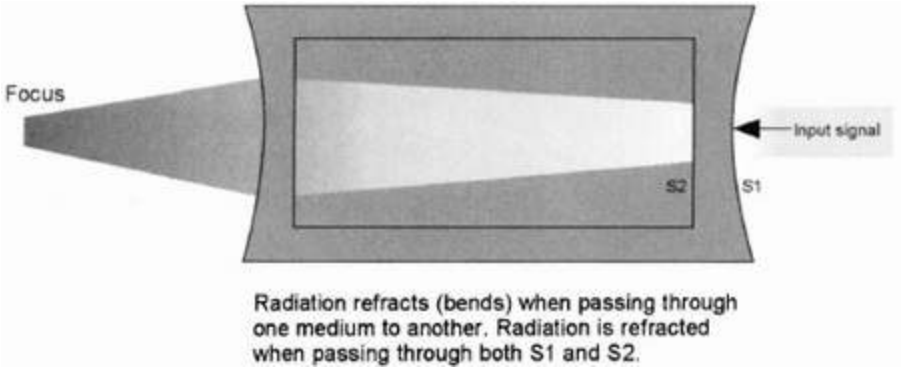

Focus
Input signal
S2
S1
Radiation refracts (bends) when passing through one medium to another. Radiation is refracted when passing through both S1 and S2.

FIGURE 58. ***Lens Effect of the Granite Box***

With the preceding data, we can explain many mysteries found in and around the King's Chamber. Compelling evidence clearly identifies the King's Chamber as the power center of the Giza power plant and strongly suggests that microwave energy was flowing through the southern "air shaft" and utilized on the outside. However, as I said earlier, any theory purporting to explain the purpose of the Great Pyramid should explain *all* noted phenomena. We still have not addressed the purpose for the Queen's Chamber, Horizontal Passage, Well Shaft, and Subterranean Pit. Neither have we studied how the hydrogen gas may have got inside the pyramid. As a matter of fact, we can answer all of these questions if we look more closely at the Queen's Chamber, where we will find the evidence that proves it was used to generate hydrogen, the fuel that ran the Giza power plant.

Chapter Eleven

A HYDROGEN GENERATOR

I *am indebted to Rudolph Gantenbrink for his exploration of the* Southern Shaft in the Queen's Chamber. I can understand his frustration at not being allowed to explore further inside the Great Pyramid, but am delighted that his discovery at the end of the shaft provided conclusive evidence for what I am about to discuss in this chapter.

Without hydrogen this giant machine would not function. It was the medium by which the energy drawn through the Great Pyramid was converted and transmitted to the outside. The hydrogen for the operation of the maser was generated by a chemical reaction in the Queen's Chamber. The characteristics and discoveries in this chamber strongly suggest that two solutions—such as hydrated zinc chloride and a dilute solution of hydrochloric acid—may have been introduced to cause a chemical reaction that produced hydrogen. There are other ways to create hydrogen, such as electrolysis; however, I am going to discuss only one method and the evidence that exists to support it.

The Queen's Chamber is located in the center of the pyramid. There are two shafts leading to this chamber which were bored into the wall block and terminated five inches from the inside wall of the chamber, leaving what Smyth described as a "left" (see Figure 59). The discovery of these enigmatic shafts came in 1872 when Waynman Dixon was able to thrust a rod through a small crack in an otherwise perfectly fitted wall and then chiseled through the limestone. Dixon noted that the limestone "left" was particularly soft in that area. Emboldened by this important discovery he measured off the same distance on the other wall and discovered another shaft. The channels were quickly theorized to be air channels; and it was surmised that the builders were not required to ventilate this chamber at the time of building, but were making preparations in case they might change their minds at a later date.

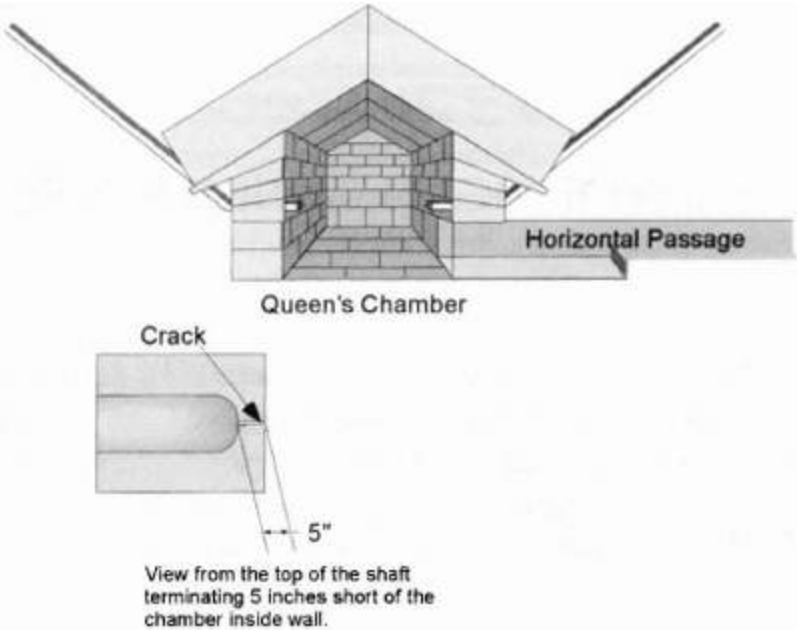

Horizontal Passage
Queen's Chamber
Crack
5"
View from the top of the shaft terminating 5 inches short of the chamber inside wall.

FIGURE 59. ***Queen's Chamber Shafts***

While some Egyptologists have proposed that the shafts leading to the Queen's Chamber were included in the design to provide air to that chamber, there is a simple and obvious fact that proves the theory to be wrong. A shaft cannot pass air from the outside to a chamber if the shaft is blocked at both ends—as the Queen's Chamber shafts are. Therefore it is amazing that such a speculation would be made. Even if these shafts were open at both ends, they do not have the most efficient design to be air shafts. Although it could be argued that the shafts were built on an incline to make the shortest route to the outside, a horizontal—albeit longer—shaft would be quicker and easier to build. For a horizontal shaft, the faces of the blocks and the channel that runs through each block, comprising the walls and ceiling of the shaft, would not have to be cut on an angle (see Figure 60). Neither would the surface that provided the floor for the shaft. The blocks could sit on a single course of masonry.

Smyth is credited for noting another anomaly in the Queen's Chamber—there were flakes of white mortar exuding from stone joints inside the shaft. Analysis of the mortar found it to be plaster of paris—gypsum (calcium sulfate). Smyth also described this chamber as having a foul odor, which caused early visitors to the chamber to beat a hasty retreat, and it was assumed that tourists were relieving themselves, though the way Smyth

described this chamber, few people stayed long enough to do so. However, as I will make clear, this odor may not have been the result of unhygienic conditions but of the chemical process that once occurred in the Queen's Chamber.

One of the greatest mysteries of this chamber has been the salt encrustation on the walls. It was up to one-half-inch thick in places, and Petrie took it into account when he made measurements of the chamber. The salt also was found along the Horizontal Passage and in the lower portion of the Grand Gallery. How did salt come to build up on the walls?

Those who have seen some significance in the presence of the salt have speculated that it could have been deposited on the walls as the water of the biblical Great Flood receded. Others have speculated that the Great Pyramid and its neighbors were surrounded by water at one time. There has been no evidence, however, to support such speculations; in fact, one researcher, after clambering over the sides of the Great Pyramid looking for water marks, concluded that such speculations were groundless.

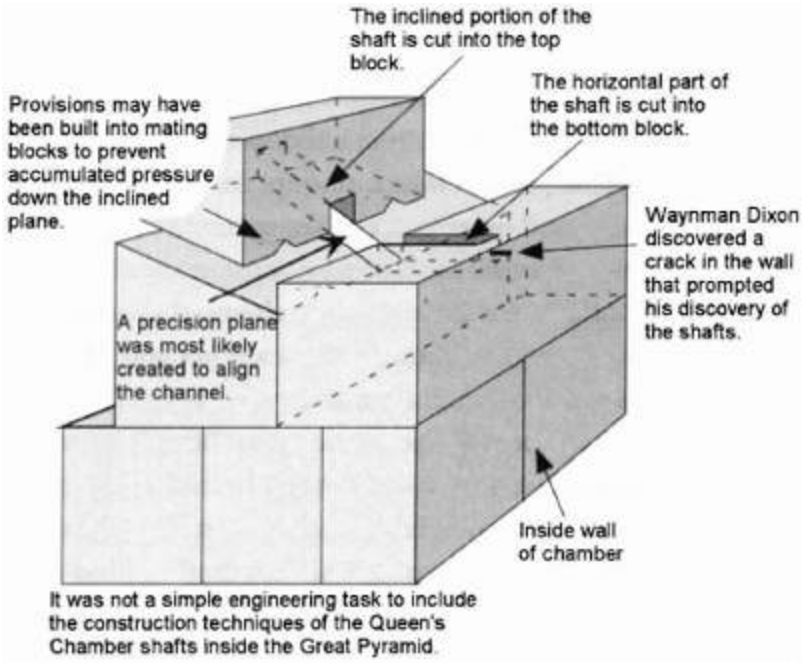

The inclined portion of the shaft is cut into the top block.
The horizontal part of the shaft is cut into the bottom block.
Provisions may have been built into mating blocks to prevent accumulated pressure down the inclined plane.
Waynman Dixon discovered a crack in the wall that prompted his discovery of the shafts.
A precision plane was most likely created to align the channel.
Inside wall of chamber
It was not a simple engineering task to include the construction techniques of the Queen's Chamber shafts inside the Great Pyramid.

FIGURE 60. ***Southern Shaft in the Queen's Chamber***

The flood and groundwater theories do not account for the salt found in the Great Pyramid, but proponents of these theories might be right about one thing—the existence of the salt itself suggests that the Queen's Chamber was

designed to take in fluid rather than air. The power plant theory explains why fluid may have been introduced into the pyramid and how it produced the salt encrustations on the walls. Nearly all of the facts that have so mystified Egyptologists fit logically together if the Queen's Chamber was once used to create hydrogen to fuel this power plant.

Salt is a natural by-product of the reaction designed to produce hydrogen. It would form when the hot, hydrogen-bearing gas reacted with the calcium in the pyramid's limestone walls. If the half-inch of salt on the Queen's Chamber walls were the result of repeated inundations—not of water—of chemicals, those used to create the fuel that powered the plant, it is unlikely that any of this chemical fluid would find its way into the bottom part of the Grand Gallery. The orientation of the passage leading from the Queen's Chamber would take the chemicals down into the Well Shaft and into the Subterranean Pit. Because the greatest concentration of heat would be inside the Queen's Chamber, with a gradual cooling off as the gas made its way into the Grand Gallery, the buildup of salt would diminish along with the heat. This process would account for the presence of salt in the Queen's Chamber and other parts of the pyramid and also for its uneven distribution in these areas.

The kind of salt that is created in a chemical process depends on the chemicals involved in generating the gas. I am not going to argue for a particular combination of chemicals, and say that is the combination the ancient Egyptians used. But I will present one feasible combination—suggested to me by a chemical engineer—with the understanding that the pyramid builders may have used a different one. Before I proceed, however, we must consider the material the pyramid builders used to bind those limestone blocks adjacent to the shafts in the Queen's Chamber. We remember that Smyth noted a white, flaky material exuding from the joints of these blocks. He was sufficiently interested in this material to have it chemically analyzed, and it was found to be gypsum, or plaster of paris. However, it is possible that this material was not used by the builders in this area at all, and if not, then we are provided with another clue to the real purpose of the Queen's Chamber. Let us briefly detour in order to find out a little more about exactly what plaster of paris is and how it could have come to be in the shafts of the Queen's Chamber.

Plaster of paris is dehydrated gypsum, which, when moistened with water,

sets in a relatively short time. It got its name because gypsum was widely used near Paris to make plaster and cement. In nature, gypsum is a form of sedimentary rock, formed by the precipitation of calcium sulfate from seawater. It also is found in various other saline deposits.

It is possible that the ancient Egyptian builders used plaster of paris in the joints in the shafts to retard the absorption of fluid into the surrounding masonry. However we should not exclude other possibilities—one of which is another method of creating gypsum that could lead to some extremely interesting conclusions. Gypsum also is produced through the action of sulfuric acid on limestone, and, although this in itself does not prove that sulfur and/or its by-products were used in the chemical process in this chamber, it does promote the consideration of other data in a new light. Because the pyramid's building materials contain one of the elements needed to produce gypsum (the limestone masonry), it follows that the introduction either accidental or purposeful—of another necessary element (sulfuric acid, for instance) would produce gypsum.

Several questions come to mind in light of the preceding speculations. They may be totally unrelated, but it would be interesting to know the answers to the following:

- Was the disgusting smell that caused early explorers to beat a hasty retreat from the chamber connected to a chemical process that used sulfur? Hydrogen sulfide is particularly odorous, exuding a smell similar to rotten eggs. This gas is formed by the combination of sulfur with hydrogen. While early explorers expected to be confronted with a certain amount of bat dung inside the pyramid, it seemed as though the smell in this particular chamber was more pronounced than in the rest of the pyramid. Again, the composition of the salts on the chamber's walls may help clarify this investigation, as sulfur-bearing compounds may have formed these salts.
- Where did Caviglia get the chunks of sulfur that he burned in the Well Shaft? While it was a practice of early explorers to burn sulfur to purify unhealthy air, it would be most helpful to know whether or not he had the sulfur with him or if it was already there.
- If a chemical exchange process was separating hydrogen and if a

> catalyst was being used in the Queen's Chamber, would sulfur playa part in the operation or perhaps regeneration of the catalyst?[1]

The shafts leading to the Queen's Chamber revealed other oddities that may help our investigation into its true function. In these channels, explorers found a small bronze grapnel hook, a piece of wood, and a stone ball. Though their discovery was much publicized at the time, Egyptologists say little about these artifacts today; and if Graham Hancock and Robert Bauval had not showed an interest, the experts would probably have preferred to leave it at that. Hancock and Bauval took it upon themselves to search for these relics. They contacted Egyptologist I.E.S. Edwards and the British Museum in 1993, but were told that they had no knowledge of them. The *Independent*, a British national newspaper, published an interview with Edwards in which he categorically denied any knowledge of these artifacts. Surprisingly, the following week, Dr. Vivian Davies, the Keeper of Egyptian Antiquities at the British Museum, stated in a letter to the *Independent* that the relics were in a cigar box in his department's keep. Subsequent investigation by Hancock and Bauval revealed that in 1972, Edwards had received the relics and recorded them in the museum's log.[2]

Was the fiasco surrounding the search for these relics a deliberate deception by Egyptologists? I seriously doubt it. These relics are pieces of evidence that do not fit into the orthodox tomb theory, so they probably had not been given any thought since the day they were delivered to the museum. Even if it was deceit—and the museum had intentionally kept them hidden—having the relics now on display does not answer the question of why they were in the pyramid in the first place. Several questions remain unanswered regarding the discovery of these items, and the items themselves, that prevent any assertion as to their intended purpose:

- Was there just one of each item?
- Were they found together in the same shaft?
- Were they in any way connected?
- Was their removal from the shaft difficult or easy?

If we work on the premise that the items were discovered in the same shaft and were connected in some way, or were able to be joined together, we could theorize that they might have been part of the switching mechanism that signaled the need for more chemicals. This hypothesis makes sense when viewed in context with other evidence from the Queen's Chamber. When we review the details researchers have noted inside the Queen's Chamber, all these seemingly unexplained facts fall into place, if our explanation is founded on the basic premise that some kind of chemical reaction was taking place there.

There is a corbelled niche with a small tunnel cut to a depth of thirty-eight feet, ending in a bulb-shaped cavern. Hydraulics engineer Edward Kunkle (of Ohio and now deceased) questioned the official explanation that this tunnel was cut by treasure seekers and claimed instead that with its flat, level floor and its almost perfect right-angled left side, it must have been part of the original construction. What is more, in Kunkle's view its features show it could have served a mechanical purpose. Kunkle proposed that it was part of a large ram pump, which also involved other features located inside the Great Pyramid.

In his book *5/5/2000 Ice: The Ultimate Disaster,* Richard Noone focused upon the mysteries of this chamber and asked a tantalizing question. Noone went further in his search for reasons for the presence of salt in this chamber. He interviewed Dr. William Tiller of Stanford University, whose research deals with the science of crystallization, surfaces, and interphases between two media, a science concerning biomaterials and psychoenergetics. Other than an interesting comment on "energy resonances" that he says would be particularly good to excite things in a pyramid, Tiller could not shed any light on the cause of the mysterious salt encrustations. Noone, however, had an enlightening dialogue with him:

Noone: Dr. Tiller, why would the Middle Chamber of the Great Pyramid be such a magnet, or repository for these crystals?

Tiller: That's really tough to imagine, because you basically have got to have (a) either some salt water which was in there and evaporated and then deposited this because it got very hot, or (b) it was at some time under the ocean and the water seeped in, or (c) somehow the "energies"

> converted what was in the walls to sodium chloride. None of these, however, makes any sense at all to me. I regret I don't have, at this point in any event, a really good answer for you.[3]

I was hoping to be able to get into the Queen's Chamber while I was in Egypt in 1986 to get a sample of the salt for analysis. I had speculated that the salt on the walls of the chamber was an unwanted, though significant, residual substance caused by a chemical reaction where hot hydrogen reacted with the limestone. Unfortunately, I was unable to get into the chamber because a French team was already inside the Horizontal Passage, boring holes into what they hoped were additional chambers. (It was discovered, after I left Egypt, that the spaces contained only sand.)

As it turned out, my research would have been redundant. Noone reported in his book that another individual had already had the same idea and done the work. In 1978, Dr. Patrick Flanagan asked the Arizona Bureau of Geology and Mineral Technology to analyze a sample of this salt. They found it to be a mixture of calcium carbonate (limestone), sodium chloride (halite or salt), and calcium sulfate (gypsum, also known as plaster of paris). These are precisely the minerals that would be produced by the reaction of hot, hydrogen-bearing gas with the limestone walls and ceiling of the Queen's Chamber.

Armed with this information, I sought out a chemical engineer, Joseph Drejewski, to see if my perception regarding the Queen's Chamber was plausible. He was skeptical about my entire premise but agreed to look at the data and form an evaluation.

I had speculated that the five-inch "left"—which contained a small hole through to the channel—that prevented each shaft from joining with the Queen's Chamber was intentionally designed to meter a specific amount of fluid into the chamber over a period of time. If we knew the head pressure of the fluid, we could accurately calculate the amount of fluid that flowed through this "left". One of these two shafts has a different discoloration, or staining, and I speculated that this was the result of the ancient Egyptians introducing two different chemicals into the chamber, which, when combined, would produce a reaction. Drejewski agreed that two chemical solutions could be introduced into this chamber to create hydrogen or

ammonia under ambient conditions of 80° Fahrenheit, ± 20°. He agreed that the niche in the wall of the chamber could have been used to house a cooling or evaporation tower. The corbelled niche inside the reaction chamber would have provided an anchor for this tower, which also may have contained a catalyst (see Figure 61). One scenario could be that the chemicals pooled on the floor of the chamber and wicked through the catalyst material. The offset of the niche may indicate the proportion of each chemical introduced into the chamber. Drejewski, therefore, agreed that my theory was plausible.

To evaluate my theory further, we must now move from considering the technology of this machine to the fuel that ran it. Let us consider how hydrogen is made and used to produce energy (see Figure 62). Drejewski prepared a report informing me of the following:

> *Hydrogen is most easily obtained by displacing it from acids by contact with certain metals that are more active than hydrogen and therefore will combine more readily with the other constituents of the acid. Zinc (Zn) is the most commonly chosen metal and when treated with dilute hydrochloric acid (HCl), it will produce a reasonably pure hydrogen gas which evolves at a relatively fast rate. The hydrogen gas produced by this reaction of zinc with hydrochloric acid may contain water vapor carried along by the gas as it bubbles through the water solution. If impurities are present, it is possible to remove the water vapor (with the impurity) bypassing the generated gas over or through a drying agent such as calcium chloride (Ca Cl_2), which retains the water vapor, but does not react with the hydrogen gas. Other metals which can be used [as a drying agent] are magnesium and finely divided iron (powder).*[4]

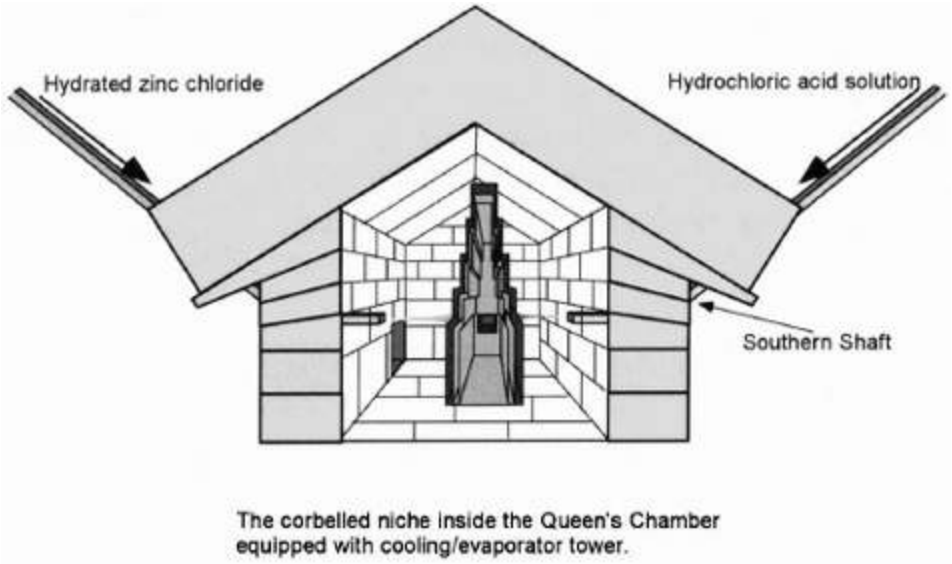


FIGURE 61. ***Cooling/Evaporator Tower***

Drejewski ended his evaluation by cautiously stating, "It is highly probable that [through this reaction] impurities such as calcium sulfate (gypsum) and sodium chloride (halite) can be leached through limestone [calcium carbonate] ($Ca\ CO_3$)."

I have been asked by other researchers who have reviewed a synopsis of my theory whether electrolysis could have played a part in the generation of hydrogen. I am not going to rule that out completely, but electrolysis would require only one shaft leading to the chamber, as it is a process using only water and electrical power. We have to explain the reasons for two similar shafts, and the dark staining inside the Northern Shaft. This staining dearly indicates the use of two different chemicals.

Additional evidence to support the theory that chemicals were flowing down these shafts came in 1993, when Rudolph Gantenbrink guided his robot Upuaut II up the Southern Shaft and discovered the so-called "door" with its copper fittings. We will remember that Smyth noted gypsum exuding from the joints of the Southern Shaft leading to the Queen's Chamber. The filming of this channel by Gantenbrink's robot revealed signs of erosion in the lower portion of the shaft. The walls and floor of the channel were extremely rough, and the erosion of the walls appeared to have horizontal striations. There also were signs of what appeared to be gypsum leaching from the limestone walls. Having reached an opinion regarding the function of the Queen's Chamber in

the Great Pyramid, I was quite intrigued when the discoveries in this channel were publicized. I did not know if my speculations would be bolstered by what was found there or if I would have to throw them out. As it happened, my theorized function of the Queen's Chamber within the Giza power plant was strengthened.

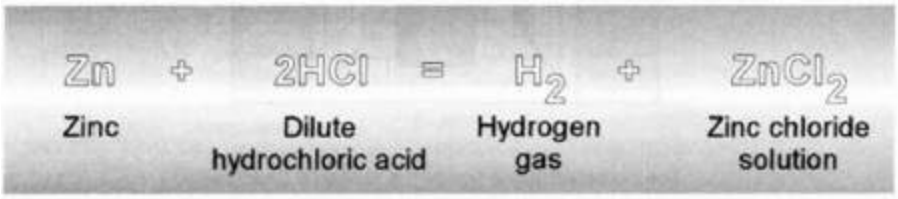


FIGURE 62. ***The Chemical Process to Produce Hydrogen***

I have proposed that the Queen's Chamber was designed to allow the necessary chemical elements into the chamber at a metered rate. However, considering that the limestone masonry blocks inside the Queen's Chamber had perfectly fitted joints, we could reasonably ask if the crack in the wall was really an anomaly or if, instead, it was part of the original design. In the context of my theory, and if so designed, this "left" with the crack in it could have served to meter the chemicals into the chamber.

Gantenbrink's robot came to a dead end at the upper part of the Southern Shaft. It encountered a block of limestone with two mysterious copper fittings protruding through it. It was widely publicized that a hidden door had been found inside the Great Pyramid (see Figure 63). What was not publicized, however, is that the shaft itself is only about nine inches square. The so-called "door," I believe, is a misnomer. As for the copper fittings—in the documentary they are presented as being stops to prevent the limestone block in which they are located from being raised. But this explanation does not fit. Why would the pyramid builders want to include a sliding block in an inaccessible area? And even if they did, how was it activated?

While I was watching the video of the exploration with my friend, Jeff Summers, he off-handedly remarked that the fittings looked like electrodes. His observation made sense to me. To deliver an accurate measure of hydrochloric acid solution to the reaction chamber, a certain head pressure would need to be maintained. The head pressure is determined by the volume of fluid in the channel, that is, the weight of the column of chemical. The

copper fittings would have served as a switch to signal the need for more chemicals. Floating on the surface of the fluid would have been another part of this switch—the cedarlike wood joined together with the bronze grapnel hook. This assembly would rise and fall with the fluid in the channel. With the channel full, the bronze prongs would have made contact with the electrodes, creating a circuit, and as the fluid in the channel dropped, the prongs would move away from the electrodes, thereby breaking the contact and acting as a switch to signal the pumping of more chemical solution into the channel until the bronze hook again made contact with the electrodes (see Figure 64). As the rate of supply into the reaction chamber was slight, a small opening was all that was needed to maintain the supply of chemicals. The limestone door with its copper fittings, brought into the view of the camera when Upuaut II had gone as far as it could, has a slight gap at the bottom, under which the robot's laser light disappeared. There also is a notch in the bottom right-hand corner. All these features serve to support the speculation that the Egyptians were supplying a fluid to the Queen's Chamber shafts, and it was necessary to maintain the fluid level in the shafts so that the weight of the fluid assured a constant and precise flow through the "left" in the chamber wall.

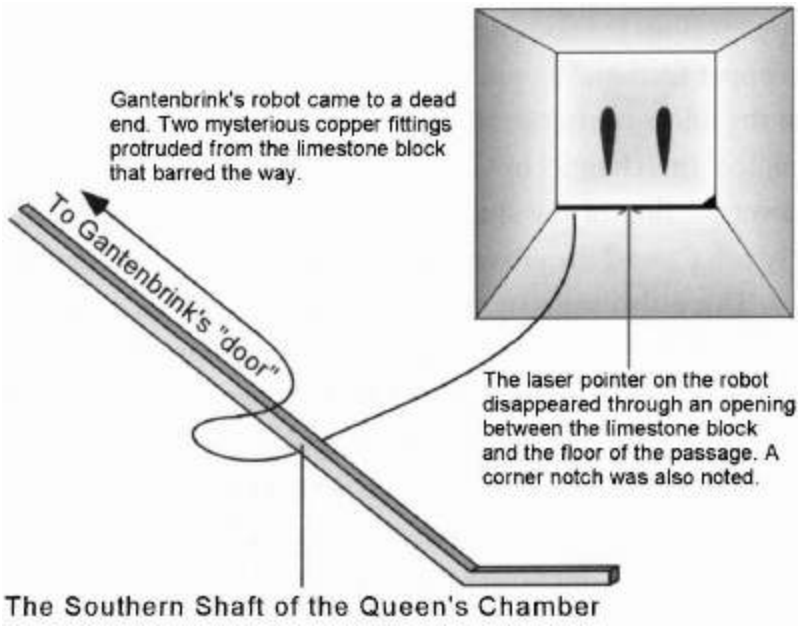

Gantenbrink's robot came to a dead end. Two mysterious copper fittings protruded from the limestone block that barred the way.
To Gantenbrink's "door"
The laser pointer on the robot disappeared through an opening between the limestone block and the floor of the passage. A corner notch was also noted.
The Southern Shaft of the Queen's Chamber

FIGURE 63. ***Gantenbrink's "Door"***

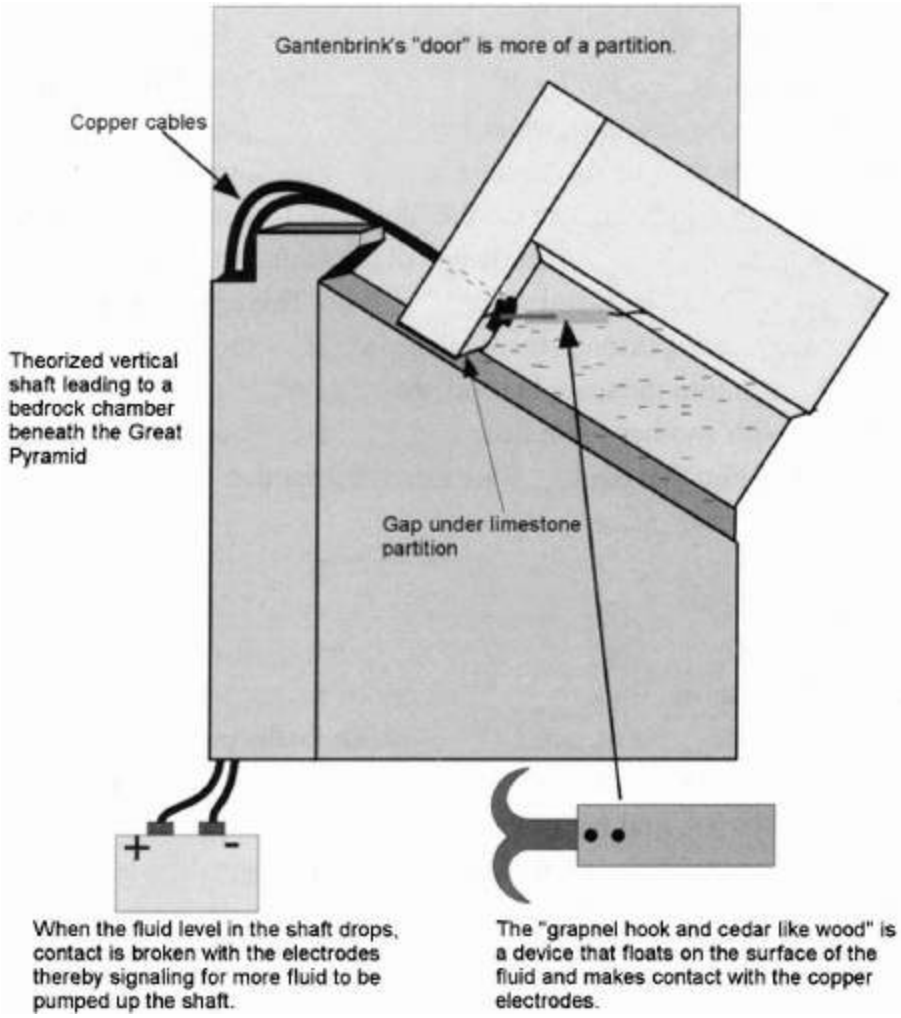

Gantenbrink's "door" is more of a partition.
Copper cables
Theorized vertical shaft leading to a bedrock chamber beneath the Great Pyramid
Gap under limestone partition
+
-
When the fluid level in the shaft drops, contact is broken with the electrodes thereby signaling for more fluid to be pumped up the shaft.
The "grapnel hook and cedar like wood" is a device that floats on the surface of the fluid and makes contact with the copper electrodes.

FIGURE 64. ***Fluid Switch***

Where the robot ended its trek up the Southern Shaft, the walls, ceiling, and floor of the shaft were smooth, as they would have been when first fitted together. On the other hand, the texture of the walls and floor of the shaft at the lower level—as photographed by Gantenbrink—was deeply eroded, with horizontal striations, and there also appeared to be leaching of salts on the surface of the ceiling and the walls. Both of these conditions could have been caused by a chemical fluid.

The recent investigation by Tom Danley in the Great Pyramid took him into the Queen's Chamber, where he tested the Southern Shaft using an acoustic device. By calculating the time it took for the sound wave to travel the distance of the shaft, bounce off the "door," and return to the sensing device, he was able to determine the length of the shaft. But Danley detected

something else. The device heard a secondary echo. This echo was produced by the sound squeezing through the small gap at the bottom of the door and traveling through into the space beyond, the space where Gantenbrink had offered to go with another robot but was denied the opportunity. Danley's instrument told him that the sound wave traveled another thirty feet before bouncing back to the source.

Notwithstanding the fact that there is no tangible evidence of what lies behind Gantenbrink's "door," what has been discovered fits extremely well into the power plant theory. It also allows us to extrapolate, for the present, what lies hidden from view and predict what further explorations may uncover when the block Gantenbrink discovered is finally penetrated. A hint of what might be there came in 1992 when French engineer and professor Jean Leherou Kerisel, and his team, conducted ground-penetrating radar and microgravimetry tests in the short horizontal passage that leads from the Descending Passage to the Subterranean Pit. He detected a structure under the floor of the passageway which he analyzed as possibly being a corridor oriented SSE-NNW and with a ceiling at the same depth that the Descending Passage would have reached had it been continued.

Hancock and Bauval reported on Kerisel's findings:

> *Nor was this all. A second very clear anomaly, a "mass defect" as Kerisel calls it, "was detected on the western side of the passageway six metres before the chamber entrance. According to our calculations, this anomaly corresponds to a vertical shaft at least five metres deep with a section of about 1.40 Ã— 1.40 metres very close to the western wall of the passageway."*
>
> *In short, what Kerisel believes he has identified off the Subterranean Chamber's entrance corridor is something that looks very much like a completely separate passageway system, terminating in a vertical shaft. His instruments may have misled him, or, as he himself admits, he may merely have picked up the traces of "a large volume of limestone dissolved by the action of underground water—in other words a deep cave". Alternatively, however, if the "mass defect" turns out to be a man-made feature, as he strongly suspects, then "it may lead to very interesting developments."*[5]

Kerisel's findings indicate that the supply shafts leading to the Queen's Chamber may have been supplied with chemicals by means of a vertical shaft that connected to an underground chamber. It should be noted that Kerisel detected the vertical anomaly on the west side of the passageway. The shafts leading to the Queen's Chamber are oriented to the west of the passageway. In light of my proposed use for these shafts, and of Kerisel's discovery, it would not be out of order for us to postulate that when Gantenbrink's "door" is penetrated, or when the clandestine diggers above the King's Chamber reach their destination, a vertical shaft leading to a bedrock chamber will be found. I also would not be surprised if more copper, in the form of cables or wires that had been attached to the "copper fittings," are found beyond Gantenbrink's "door" (refer to Figure 64).

We can now understand how chemicals were introduced to the Queen's Chamber and caused a reaction that filled all the cavities within the Great Pyramid with hydrogen. But during the fueling process, moisture and impurities would had to have been removed from the gas. How was this done? The means existed to remove water vapor and impurities from hydrogen gas. The gas had already given up some moisture and impurities in the Queen's Chamber, leaving salt encrustation on the walls and ceiling. The long Horizontal Passage that connects the Queen's Chamber with the Grand Gallery, being constructed out of limestone—the same material as the Queen's Chamber—would work in the same manner and remove residual moisture and impurities from the gas as it filled that passage and flowed toward the Grand Gallery.

At the juncture where the Horizontal Passage meets the Ascending Passage is a five-inch lip. There may have been a slab resting against this lip and bridged between the Ascending Passage and the floor of the Grand Gallery, where a similar lip is found. Slots in the sidewall indicate that there may have been supporting members for this slab, which would have had holes drilled into it to allow the gas to rise into the Grand Gallery. At this juncture, and to the west, a hole in the wall leads to what is known as the Well Shaft. Perhaps the Well Shaft is the only feature of the Great Pyramid that has been accurately named. Spent chemical solution from the Queen's Chamber would have flowed along the Horizontal Passage and down the Well Shaft into either the Grotto or, if the shaft at that time connected to the lower

Descending Passage, the Subterranean Pit below. The lip and a bridging slab would have prevented the fluid from flowing down the Ascending Passage (see Figure 65).

One of the questions that always arises regarding my theory about the Great Pyramid, and one that should be on our minds at present, is what happened to the original equipment that sustained the operation of the power plant? While it is a generally accepted belief that some objects have been removed from the Great Pyramid, it is impossible to define exactly what was removed, when it was removed, and who removed it. Tradition teaches us that it was a king's mummy and vast treasures that made grave robbing such a lucrative business in Egypt. However, considering the proposition in these pages, other treasures removed from the Great Pyramid were far more valuable than the funerary trappings that accompanied an Egyptian king. Why these objects were removed and by whom I cannot say, but the features we examined from the King's and Queen's chambers, and from the Grand Gallery and its juncture with the Horizontal Passage, lend themselves to speculation that objects were there and provide us a clue to what these objects were. As I have just argued, I believe these objects were parts of a great machine, the Giza power plant. The evidence in the Queen's Chamber (see Figure 66) alone points to a finely tuned operation that used a chemical reaction to create hydrogen. Let us review this evidence.

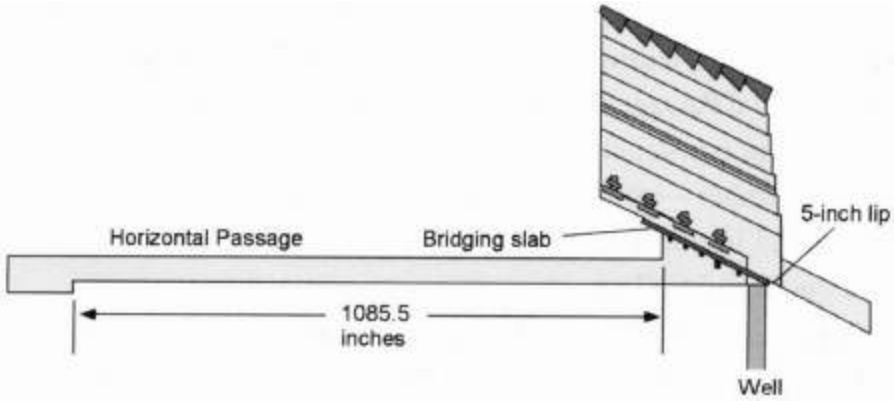


FIGURE 65. ***Bridging Slab***

- *five-inch lip at juncture of Ascending Passage and Horizontal Passage.* This could serve to prevent waste from flowing down the Ascending Passage.

- *drop in Horizontal Passage floor level before it goes into the Queen's Chamber.* This would allow chemicals to pool inside the chamber and "wick" up the evaporation tower (refer to Figure 62).
- *corbeled niche in wall of the Queen's Chamber.* This may have been a means to "key" the evaporation tower into the structure.
- *shafts leading to the Queen's Chamber but not quite connected to it.* These could have been supply shafts for chemicals needed in the reaction. The shafts would allow chemicals to enter the chamber and prevent evolving gases from escaping.
- *stone ball, grapnel hook, and cedarlike wood.* The wood and hook assembly could have served as a floating contact to signal the need for more chemical. The stone ball may have been used to prevent erosion of the "left" as the channel filled with fluid.
- *flakes of gypsum exuding from joints in shafts.* This substance probably resulted from the chemical reacting with limestone (suggesting the use of sulfuric acid).
- *buildup of salt crystals on the walls and ceiling of the Queen's Chamber, Horizontal Passage, and lower level of Grand Gallery*. This buildup was likely the result of gaseous vapor passing over the limestone, reacting with the calcium in the limestone, and giving up water and impurities. This was a by-product from the drying of the gas.
- *Well Shaft bored from the juncture of the Grand Gallery and the Horizontal Passage down to the Grotto.* This was probably either a waste removal shaft or an overflow shaft.
- *large granite block at the bottom of the Well Shaft at the level of the Grotto.* Most likely this was put into place to catch the chemical overflow, thereby preventing erosion of the limestone.

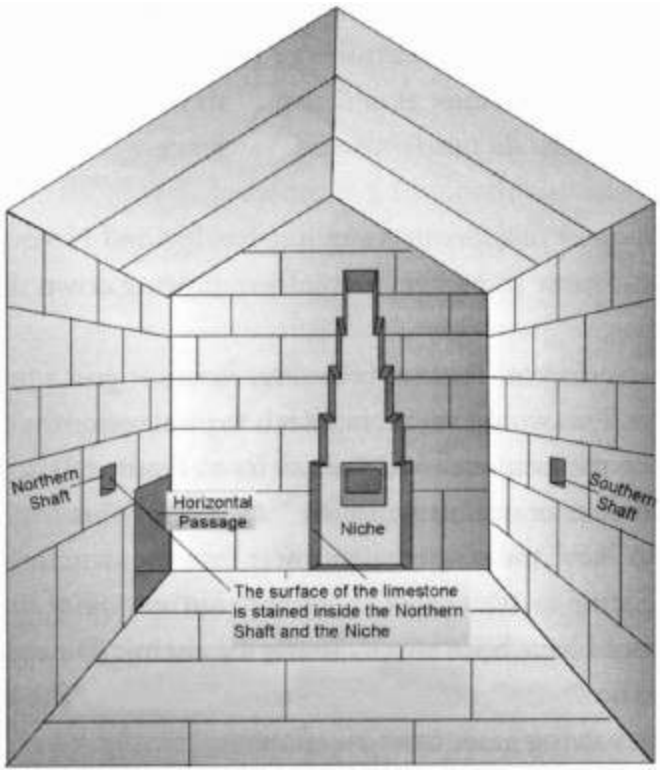

Northern Shaft
Horizontal Passage
Niche
Southern Shaft
The surface of the limestone is stained inside the Northern Shaft and the Niche

FIGURE 66. ***Niche Inside the Queen's Chamber***

It is unfortunate that such havoc was wreaked inside the Great Pyramid as early explorers bored and tore away barriers. The Descending Passage and the Well Shaft were recipients for much of the refuse from those expeditions. More recently another area of the pyramid has allegedly been used as a waste disposal site for limestone residue from tunneling. There are speculations that there is a clandestine effort to reach Gantenbrink's "door" by tunneling from one of the chambers above the King's Chamber. Tom Danley reported that the limestone chippings from this effort were being placed in burlap bags and taken to another chamber above in an effort to keep the project a secret. If this is true, we have reason to worry, for if the tunnelers ultimately reach their destination, who knows what damage they ill inflict in this area? In a manner similar to explorations of earlier times, valuable features may be destroyed—by the pickaxes and chisels of these modern treasure seekers—because they are unrecognizable within the context of a tomb.

Chapter Twelve

MELTDOWN

Much of the evidence that supports the theory that the Great Pyramid was a power plant is the result of a malfunction of the generation process. The hydrogen in the power center (King's Chamber) for some inexplicable reason exploded in an awesome ball of fire, and the power plant suffered a "meltdown." The King's Chamber was affected in a disastrous way. Its walls were pushed out nearly an inch and the ceiling beams cracked.

The operators of the power plant, noting that there was an interruption of the energy coming from the pyramid, had to enter the pyramid to make repairs. They spread plaster over cracks in the ceiling beams, apparently making no pretense to neatness, for the plaster was daubed on freely, almost as though they had used their fingers. The question we must ask is, Would the spreading of plaster on these giant monoliths improve the structural stability of the ceiling? Or was it for another reason that the Egyptians took the trouble to seal the cracks? It would seem that if the granite beams in the ceiling of the King's Chamber were suddenly to give way, a smear of plaster would do little to prevent them from smashing into the chamber. But if the Great Pyramid were a machine—a power plant—then the sealing of these cracks may make sense.

If the fuel that fed the operation of the power plant was hydrogen gas, it is conceivable that it was necessary for the operators to contain the gas as completely as possible—for an excessive leak might have decreased the efficiency of the power plant. Therefore, when the guardians entered the King's Chamber and found severe cracks in the ceiling, it may have made sense to them to seal the cracks while they were checking out the rest of the damage and making whatever repairs they thought necessary. Whether the sealing of the cracks was essential was probably a chance the guardians could not afford to take; after leaving the pyramid and resuming the operating

cycle, they would not have wanted to reenter the pyramid in order to repair a simple leak.

The structural displacement of the King's Chamber is not the only clue that the heart of the Great Pyramid experienced a powerful release of energy. Another supporting clue which may have been the result of the same events that caused the disturbance in the King's Chamber, was found in one of the so-called "relieving" chambers above. As we recall, when Howard-Vyse's men blasted through tons of limestone and granite and discovered the four chambers above Davison's Chamber, the first part they went into had a strange effect on them. They crawled out of the air space covered from head to toe with a fine, thin black powder. The floor of the chamber was covered with it. Analysis of the powder showed it to be exuviae, the cast-off shells and skins of insects.

This discovery has remained a mystery. Where did the exuviae come from? None of the other chambers contained it. The space directly above the King's Chamber contained nothing but bat dung. There were no living insects found in the Great Pyramid, and it is doubtful that a group of insects would single out this one chamber and collectively, or repeatedly over a period of time, shed their skins.

My theory may account for this black powder. The anomalous creation of energy within the King's Chamber, which forced the granite walls away from their original position and cracked the granite beams above, also may have been responsible for the exuviae in the chamber above Davison's Chamber. Insect shells are comprised mainly of calcium carbonate, and if we look for a source for calcium carbonate in the area, we find it in the core limestone masonry itself. The core blocks of the pyramid are comprised mainly of nummulitic limestone made up of fossilized seashells and foraminifers. If there was an explosion inside the King's Chamber of sufficient magnitude to push aside hundreds of tons of granite, it is possible that with that explosion, and in the presence of elevated temperatures, the surface layers of limestone in close proximity would be affected too. The scenario may have gone like this: The initial explosion jolted the entire granite complex, pushing the walls out and lifting the ceiling beams up off their support blocks. As the ceiling beams came crashing back down, they cracked along the south end and, at the same time, some of the limestone core masonry in the spaces above the

King's Chamber may have been impacted and crushed by their fall, causing limestone dust to fill the air. As the crushed limestone hung in the air it quite literally could have cooked in the elevated temperatures of the hydrogen explosion and the fire that followed. The black calcium carbonate dust would have settled finally onto the tops of the granite beams.

The guardians, alarmed at the sudden malfunction within the power plant, then gained access to the inner chambers of the pyramid by climbing down the Descending Passage and up the Well Shaft to the level of the Grand Gallery. They cut through to what is now known as Davison's Chamber, where they inspected the next layer of granite. While in this chamber they could have cleaned away the limestone dust (exuviae) from the top of the beams, which is why the exuviae was not discovered until an opening was made by Howard-Vyse into the chamber above.

Another feature inside the granite complex known as the King's Chamber that is left unexplained by orthodox theories is the so-called sarcophagus. We have already discussed a purpose for this box, but we really have not addressed why the pyramid builders selected a type of granite for the box that was a different color than the granite with which they constructed the chamber. The box is chocolate colored, and there is no granite like that to be found in Egypt! It has been speculated that it came from the Americas or the mythical Atlantis. If this is true, why would the pyramid builders find it necessary to import a single, large block of chocolate-colored granite from across the world to construct a sarcophagus when they could have used red granite, of which there was plenty available in their own country?

Well, perhaps they did not.

Again my theory of the Giza power plant provides a reasonable answer. Perhaps the coffer was originally red, quarried at the same time, in the same place, as the rest of the granite used to construct the King's Chamber. If an object like this box was subjected to excessive energy levels, what would be the effects? Depending on other elements that were present at the time of the malfunction of the power plant, it is conceivable that certain changes would be recorded in any object fortunate enough to survive the accident. The comparatively thin sides and base of the coffer would naturally be more susceptible to excessive energy levels than would be the huge granite blocks comprising the walls and ceiling of the King's Chamber. It is possible,

therefore, that the granite box, because of its thinner construction, did not have the ability to conduct the heat to which it was subjected and so it simply overcooked, causing the color change. Architect Jim Hagan, who is an expert in the application of stonework in construction, explained to me that the interior chambers of the Great Pyramid have the appearance of being subjected to extreme temperatures; and he claimed that the broken corner on the granite box shows signs of being melted, rather than simply being chipped away.

The awesome force unleashed inside the King's Chamber—of such magnitude that it melted granite—also would have consumed other susceptible materials. If the resonators in the Grand Gallery were made of combustible material, such as wood, they most likely would have been destroyed at the same time. Evidence to support this speculation comes from reports that the limestone walls in the Grand Gallery were subjected to heat and, as a result, the limestone blocks calcinated or burned. The disaster that struck the King's Chamber, therefore, may have been responsible for destroying the resonators.

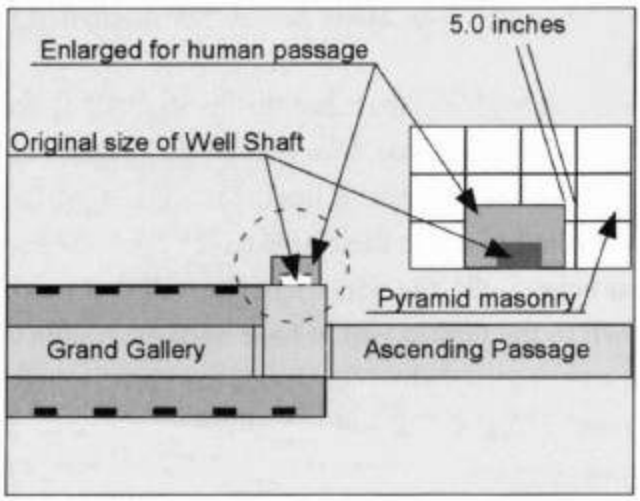
After shuddering to a stillness that they had not experienced for years, or even decades, the inner chambers of the Giza power plant lay in smoking ruins. Not knowing to what extent their machine was damaged, the operators would choose a route that would leave the interior chambers intact, in case they were able to make repairs and put the power plant back in service. The most obvious route would have been the Well Shaft. As we now turn our attention to the Well Shaft, a feature around which much debate has swirled, its existence begins to make sense in the context of my theory. Many Egyptologists credit the guardians of the Great Pyramid with carving an access tunnel—the Well Shaft—to the inside of the Great Pyramid to inspect damage from an "earthquake." This is a reasonable assumption because only those with knowledge of the internal passageways of the Great Pyramid would know where to dig their tunnel. However, considering the meandering and tortuous path of the Well Shaft, it was either a remarkable stroke of luck that their bore came out where it did, or they were in possession of some fairly advanced instruments for detecting the location of the Grand Gallery, or a connection between the Well Shaft and Grand Gallery already existed.

Petrie presented evidence that showed the Well Shaft, from the Grand

Gallery to the level of the Grotto, to be part of the original structure of the Great Pyramid. Therefore, instead of having to carve out the entire length, the guardians only had to carve their hole to the level of the Grotto. When the pyramid was being built, the portion of the well that was bored through the bedrock down to the Grotto would have been accessible to the workers. Once the work was accomplished, however, the constructed portion from the bedrock up to the level of the Grand Gallery would only need to be large enough to allow passage of the chemical overflow from the Queen's Chamber. And this is exactly what we find when we examine the Well Shaft dimensions. Petrie described the constructed portion of the Well Shaft as being rather shoddy work. Furthermore, he could not understand why a block that was used in its construction was positioned a mere 5.3 inches from the Grand Gallery wall. He wrote:

> *On examining the shaft, it is found to be irregularly tortuous through the masonry, and without any arrangement of the blocks to suit it; while in more than one place a corner of a block may be seen left in their regular curved side of the shaft, all the rest of the block having disappeared in cutting the shaft. This is a conclusive point, since it would never have been so built at first. A similar feature is at the mouth of the passage, in the gallery. Here the sides of the mouth are very well cut, quite as good work as the dressing of the gallery walls; but on the s. side there is a vertical joint in the gallery side, only 5.3 inches from the mouth. Now, great care is always taken in the Pyramid to put large stones at a corner, and it is quite inconceivable that a Pyramid builder would put a mere slip 5.3 thick beside the opening to a passage. It evidently shows that the passage mouth was cut out after the building was finished in that part. It is clear, then, that the whole of this shaft is an additional feature to the first plan.*[1]

Based on all the evidence, the only explanation for the constructed portion of the Well Shaft near the Grand Gallery is that it was enlarged to allow the guardians access to the Grand Gallery after the explosion in the King's Chamber, and this excavation resulted in the thin block of limestone on the south side (see Figure 67).



Petrie puzzled over the 5-inch thick limestone block at the mouth of the well, as it was not typical of the robust construction found throughout the rest of the pyramid.

FIGURE 67. ***Well Mouth***

Evidence that the Well Shaft was part of the original design also was proposed by Celeste Maragioglio and Vito Rinaldi, who noted that the the walls upward from the Grotto to the Grand Gallery were lined with regular blocks of limestone. They argued that because a part of this lining was through the bedrock, it must have been a part of the original design and construction.[2] The existence of a large block of granite wedged in the mouth of the Grotto provides other evidence that the Well Shaft was part of the original design. The granite, being more impervious to erosion than the limestone, may have served to catch the chemical flow from the Queen's Chamber and direct it into the deep hole to the side of the Well Shaft. If the Well Shaft did not exist until the guardians made their damage assessment inspection, then they must have taken the block of granite from somewhere inside the Great Pyramid's main passages or chambers and dropped it down the Well Shaft. It makes more sense that the granite was a part of the original design, already in place, and that the guardians, or any other theorized interlopers, only had to push it aside when they reached the level of the Grotto (see Figure 68).

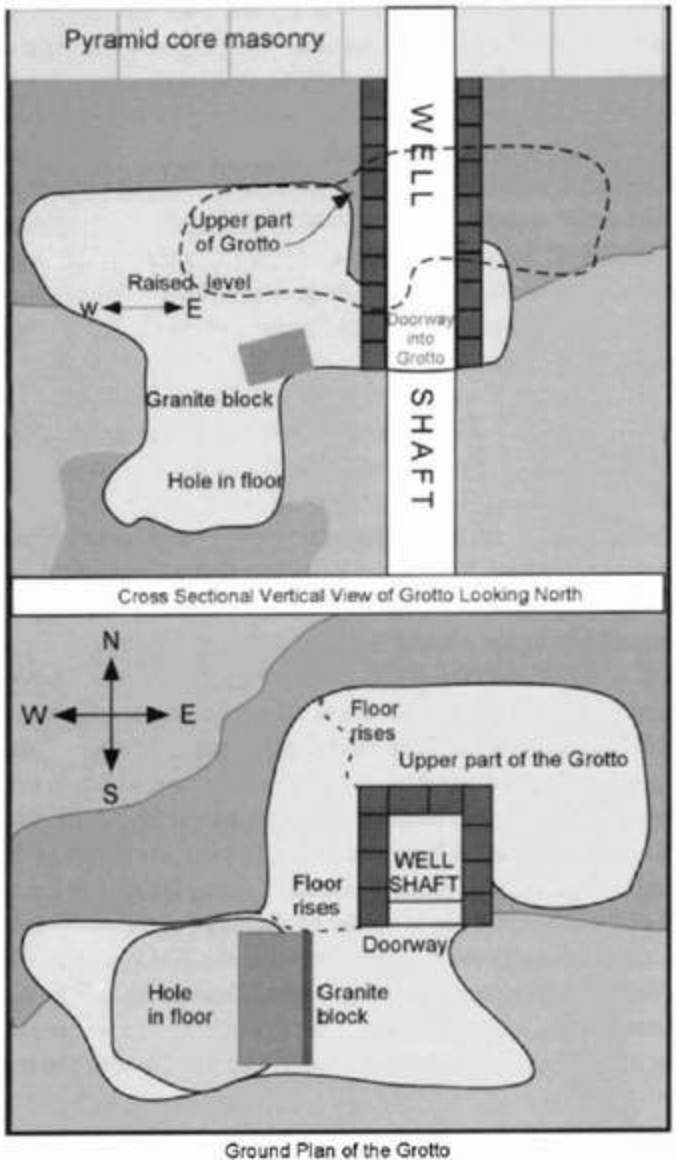


FIGURE 68. ***Grotto in the Well***

The technology utilized in the Giza power plant was unique, and its design features find no parallel in any other structure anywhere in the world. Nevertheless, new technology does not just spring into existence. It is logical to assume that, before being encased in a mountain of stone, critical technological "devices," such as the King's Chamber granite complex, Grand Gallery resonators, and Antechamber acoustic filter, were all fully developed and successfully tested to the point where building the Great Pyramid became feasible. If we were to look for evidence that the ancient Egyptians undertook such development and testing, we need look no further than one hundred

yards to the east of the Great Pyramid, where the Trial Passages are located (refer to Figure 4).

These passages, discovered by Petrie and discussed earlier in the book, include features found inside the Great Pyramid suggesting that they were planned before the pyramid's construction. However, the ancient Egyptians did not excavate the Trial Passages out of solid bedrock just to demonstrate that they knew the Great Pyramid's interior design or for "practice," as many Egyptologists propose. They had a more practical purpose for their hard work. This purpose—indeed the very existence of the Trial Passages—becomes perfectly logical when considered within the context of the power plant theory. The Trial Passages on the Giza Plateau were most likely dug to accommodate the lower parts of the equipment being developed. As with many industrial and scientific research facilities around the world, the Trial Passages were dug to economize on the superstructure, which, in all probability would have been a research and development laboratory. Similarly today, industries installing large pieces of equipment save money by digging pits and lining them with concrete instead of raising the roof. Normally, the shape of these concrete pits is similar to the shape of the equipment they will accommodate. Therefore, when we look at the Trial Passages we see the same design, measurements, and angles of the Descending Passage, Ascending Passage, and the Grand Gallery. From this information we can extrapolate how the Giza power plant's development and testing took place:

- *The Grand Gallery Resonators.* Instead of testing all twenty-seven resonators in an expensive building, they may have been developed and tested in groups of two or three in the Trial Grand Gallery. This testing may have been accomplished by simulating the vibrations from the Earth and directing sound up the Trial Ascending Passage.
- *The King's Chamber Granite Complex.* The development and testing of the complex, including the Antechamber acoustic filter, may have been accomplished elsewhere and, for testing purposes, may not have needed to rely on the work being performed in the Trial Passages. Sound could have been simulated and focused through the acoustic filter to accomplish this. There are marks on the granite beams above the King's

Chamber that establish their unique positions when being installed in the Great Pyramid. This is evidence that it was very important that each piece be installed in exactly the same position as when it was developed and tested.

- *The Queen's Chamber Reaction Chamber*. There are no Trial Passages that correspond to this feature. There is a slight indication of a Horizontal Passage, but this was probably cut to test the slab that bridges the Grand Gallery and the Ascending Passage. Considering the function of the Queen's Chamber, the fact that this chamber was not included in the Trial Passages is perfectly logical. It would be a waste of time to dig a long tunnel with a chamber at the end of it to fulfill a purpose that could be handled easily in an above-ground laboratory. They could have generated hydrogen without digging the Horizontal Passage and the Queen's Chamber, so why bother digging them?

Considering the investment the ancient Egyptians made in building such a structure, and its intended purpose as a power plant, it would be nearly unthinkable for them not to have fully tested the machinery that would be put to use. The remarkable similarity in the dimensions of both the passages in the Great Pyramid and the Trial Passages supports my speculation that every piece of equipment critical to the operation of the power plant was first fully developed and tested prior to its installation. The power plant theory currently is the only one that provides a logical pattern of events to explain the purpose for the Trial Passages.

With our knowledge of the progress of modern science, we can easily visualize the events that transpired after the builders successfully tested their equipment in their trial laboratory. Construction, if not already begun, would have been started on the largest pyramid ever built, and the equipment to be used inside would have been stored until it was convenient to install it permanently. Perhaps some improvements could have been made in the meantime, with respect to the efficiency of the equipment in terms of operation and longevity, for, once installed, it would have to operate without adjustment, maintenance, or any other human intervention. Thus, every dimension would had to have been cross-checked first and approved by the chief designer before the quarries were given the final go ahead to cut the

stone that would house this equipment of the Giza power plant. Once the pyramid itself had been completed and the equipment installed, the workers would have packed their tools and headed home while the contracting company gave the key that operated this state-of-the-art system to its new owners.

Chapter Thirteen

SUMMARY

*If my power plant theory was based on evidence from a singular ex*hibit or a few artifacts, critics and skeptics could rightly attribute that evidence to pure coincidence. However, I have amassed a plethora of facts and deductions based on sober consideration of the design of the Great Pyramid and nearly every artifact found within it that, when taken together, all support my premise that the Great Pyramid was a power plant and the King's Chamber its power center. Facilitated by the element that fuels our sun (hydrogen) and uniting the energy of the universe with that of the Earth, the ancient Egyptians converted vibrational energy into microwave energy. For the power plant to function, the designers and operators had to induce vibration in the Great Pyramid that was in tune with the harmonic resonant vibrations of the Earth. Once the pyramid was vibrating in tune with the Earth's pulse it became a coupled oscillator and could sustain the transfer of energy from the Earth with little or no feedback. The three smaller pyramids on the east side of the Great Pyramid may have been used to assist the Great Pyramid in achieving resonance, much like today we use smaller gasoline engines to start large diesel engines. So let us now turn the key on this amazing power plant to see how it operated (see Figure 69).

The Queen's Chamber, located in the center of the pyramid, and directly below the King's Chamber, contains peculiarities entirely different than those observed in the King's Chamber. The Queen's Chamber's characteristics indicate that its specific purpose was to produce fuel, which is of paramount importance for any power plant. Although it would be difficult to pinpoint exactly what process took place inside the Queen's Chamber, it appears a chemical reaction repeatedly took place there. The residual substance the process left behind (the salts on the chamber wall) and what can be deduced from artifacts (grapnel hook and cedarlike wood) and structural details

(Gantenbrink's "door" for example) are too prominent to be ignored. They all indicate that the energy created in the King's Chamber was the result of the efficient operation of the hydrogen-generating Queen's Chamber.

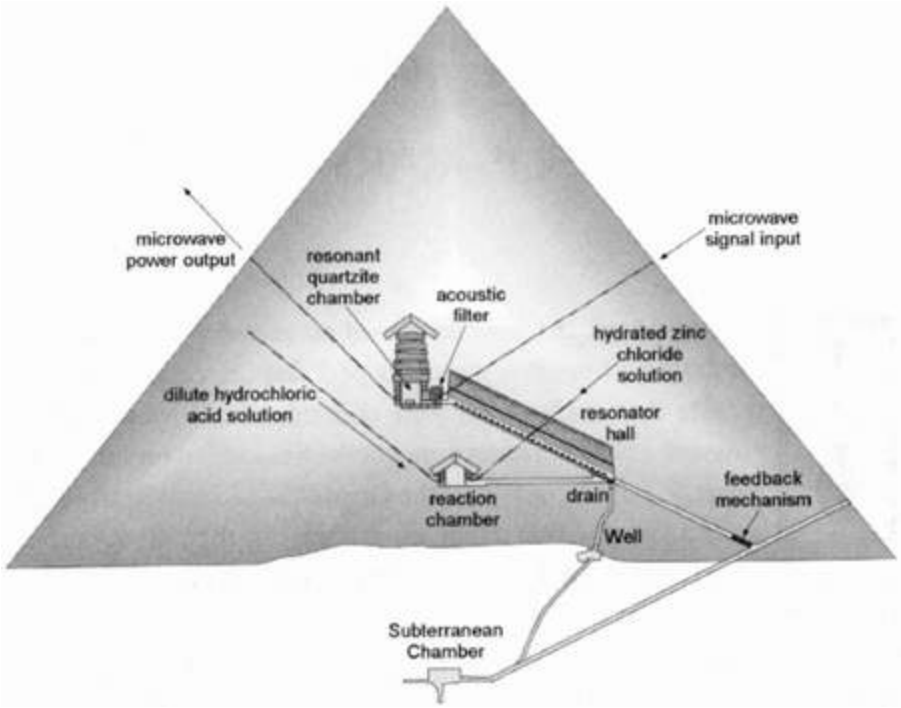


FIGURE 69. ***The Giza Power Plant***

The equipment that provided the priming pulses was most likely housed in the Subterranean Pit. Before or at the time the "key was turned" to start the priming pulses, a supply of chemicals was pumped into the Northern and Southern Shafts of the Queen's Chamber, filling them until contact was made between the grapnel hook and the electrodes that were sticking out of the "door." Seeping through the "lefts" in the Queen's Chamber, these chemicals combined to produce hydrogen gas, which filled the interior passageways and chambers of the pyramid. The waste from the spent chemicals flowed along the Horizontal Passage and down the Well Shaft.

Induced by priming pulses of vibration—tuned to the resonant frequency of the entire structure-the vibration of the pyramid gradually increased in amplitude and oscillated in harmony with the vibrations of the Earth. Harmonically coupled with the Earth, vibrational energy then flowed in abundance from the Earth through the pyramid and influenced a series of tuned Helmholtz-type resonators housed in the Grand Gallery, where the

vibration was converted into airborne sound. By virtue of the acoustical design of the Grand Gallery, the sound was focused through the passage leading to the King's Chamber. Only frequencies in harmony with the resonant frequency of the King's Chamber were allowed to pass through an acoustic filter that was housed in the Antechamber.

The King's Chamber was the heart of the Giza power plant, an impressive power center comprised of thousands of tons of granite containing fifty-five percent silicon-quartz crystal. The chamber was designed to minimize any damping of vibration, and its dimensions created a resonant cavity that was in harmony with the incoming acoustical energy. As the granite vibrated in sympathy with the sound, it stressed the quartz in the rock and stimulated electrons to flow by what is known as the piezoelectric effect. The energy that filled the King's Chamber at that point became a combination of acoustical energy and electromagnetic energy. Both forms of energy covered a broad spectrum of harmonic frequencies, from the fundamental infrasonic frequencies of the Earth to the ultrasonic and higher electromagnetic microwave frequencies.

The hydrogen freely absorbed this energy, for the designers of the Giza power plant had made sure that the frequencies at which the King's Chamber resonated were harmonics of the frequency at which hydrogen resonates. As a result, the hydrogen atom, which consists of one proton and one electron, efficiently absorbed this energy, and its electron was "pumped" to a higher energy state.

The Northern Shaft served as a conduit, or a waveguide, and its original metal lining—which passed with extreme precision through the pyramid from the outside—served to channel a microwave signal into the King's Chamber. The microwave signal that flowed through this waveguide may have been the same signal that we know today is created by the atomic hydrogen that fills the universe and that is constantly bombarding the Earth. This microwave signal probably was reflected off the outside face of the pyramid, then was focused down the Northern Shaft. Traveling through the King's Chamber and passing through a crystal box amplifier located in its path, the input signal increased in power as it interacted with the highly energized hydrogen atoms inside the resonating box amplifier and chamber. This interaction forced the electrons back to their natural "ground state." In turn, the hydrogen atoms

released a packet of energy of the same type and frequency as the input signal. This "stimulated emission" was entrained with the input signal and followed the same path.

The process built exponentially—occurring trillions of times over. What entered the chamber as a low energy signal became a collimated (parallel) beam of immense power as it was collected in a microwave receiver housed in the south wall of the King's Chamber and was then directed through the metal-lined Southern Shaft to the outside of the pyramid. This tightly collimated beam was the reason for all the science, technology, craftsmanship, and untold hours of work that went into designing, testing, and building the Giza power plant. The ancient Egyptians had a need for this energy: It was most likely used for the same reasons we would use it today—to power machines and appliances. We know from examining Egyptian stone artifacts that ancient craftspeople had to have created them using machinery and tools that needed electricity to run. However, the means by which they distributed the energy produced by the Giza power plant may have been a very different process from any we use today. Because I lack hard evidence to support any speculation about their process, I will not address that issue now, but I will offer several hypotheses in the next chapter.

Before we move into the more speculative part of the book, I would like to join architect James Hagan and other engineers and technologists in extending my utmost respect to the builders of the Great Pyramid. Though some academics may not recognize it, the precision and knowledge that went into its creation are—by modern standards—undeniable and a marvel to behold. In *Secrets of the Great Pyramid,* Peter Tompkins informed us of the opinion of professor F.A.P Barnard, of Columbia College in New York, who energetically attacked the work and ideas of Piazzi Smyth. Barnard criticized the ancient Egyptians for the "stupidly idiotic task of heaping up a pile of massive rock a million-and-one-half cubic yards in volume."[1] We can believe that the pyramid builders were primitive and that they used primitive methods of manufacturing if we choose to, but practical experience in the skills and technology that must have had a part in the creation of countless numbers of ancient artifacts in Egypt forces many people, myself included, to reject such notions. When we *know* what to look for we *cannot* ignore the evidence of advanced methods of machining! I hope this fact alone will persuade those

working in the fields of archaeology and Egyptology to take another look at this material.

The evidence presented in this book, for the most part, was recorded many years ago by men of integrity who worked in the fields of archaeology and Egyptology. That much of this evidence was misunderstood only reveals the pressing need for an interdisciplinary approach to fields that have until recently been closed to nonacademics and others outside the fold of formal archaeology and Egyptology. Much of our ignorance of ancient cultures can be placed at the feet of closed-minded theorists who ignore evidence that does not fit their theories or fall within the province of their expertise. Sometimes it takes a machinist to recognize machined parts or machines! As a result, much of the evidence that supports a purpose for the Great Pyramid as anything other than a tomb has been ignored, discounted without serious consideration, or simply explained away as purely coincidental. Is it coincidence that the Great Pyramid is so huge and so precise? That the King's Chamber contains so many indications that tremendous forces disturbed it or were created within it at one time? Are the exuviae, the chocolate-colored granite, the resonating chambers with their giant granite monoliths placed above, and the unique properties of the quartz crystal present in vast quantities in the granite complex all coincidental? Can the design and physical tests of the movement of sound inside the Grand Gallery be just a happy accident? How about the series of notches along the Grand Gallery? They had to have some purpose.

We technologists can appreciate the pride the pyramid builders must have felt after they had developed their technology and the results stood majestically against the Egyptian skyline. The Great Pyramid inspired awe, which must have been enhanced by its function, enriching the lives of the people who contributed to its construction. If our society had developed a power plant that embodied the features of the Great Pyramid, there would be a renaissance in public thought regarding power-related technology and how it affects an individual's life. If the technology that can be seen inside the Great Pyramid was replicated for our benefit, there would be less concern about the future of our technological society, for a vast renewable source of energy would be available for as long as we inhabit this planet. Water and/or simple chemicals enter at one point and energy is output from another. No

pollution and no waste. What could be simpler?

Well, it may not be quite that simple. The technology that was used inside the Great Pyramid may be quite simple to understand but might be difficult to execute, even for our technologically "advanced" civilization. However, if anyone is inspired to pursue the theory presented in this book, their vision may be enhanced by the knowledge that re-creating this power source would be ecologically pleasing to those who have a concern about the environmental welfare and the future of the human race. Blending science and music, the ancient Egyptians had tuned their power plant to a natural harmonic of the Earth's vibration (predominantly a function of the tidal energy induced by the gravitational effect that the moon has on the Earth). Resonating to the life force of Mother Earth, the Great Pyramid of Giza quickened and focused her pulse, and transduced it into clean, plentiful energy.

Besides obvious benefits from such a power source, we also should consider the benefits that could be gained by utilizing such a machine in geologically unstable areas of the planet. As we discussed earlier, over time there is an enormous amount of this energy built up in the Earth. Eventually the weak spots in the mantle can give way to these stresses, releasing tremendously destructive forces. If we could build a device to draw mechanical energy from seismically active regions of the planet in a controlled fashion—instead of it accumulating to the destructive level of earthquakes—we might be able to save thousands of lives and billions of dollars. We would have a device that would help stabilize the planet. So rather than being periodically shaky real estate, California might eventually become the United States' energy mecca, with a Great Pyramid drawing off the energy that is building up within the San Andreas Fault. A fanciful idea? Perhaps not.

If we assume that there are no coincidental features in the Great Pyramid, then the ancient Egyptians have proved that they were knowledgeable about the dimensions of the Earth, as well as its physical relationship to the sun and the moon. We can reasonably speculate that the knowledge of astronomy, embodied in the Great Pyramid, was not coincidental or a fanciful idea of the builders, but a necessary element in tuning their power plant to the pulse of our dynamic Earth.

We know very little about the pyramid builders and the period of time when they erected these giant monuments; yet it seems obvious that the entire civilization underwent a drastic change, one so great that the technology was destroyed with no hope of rebuilding. Hence a cloud of mystery has denied us a clear view of the nature of these people and their technological knowledge. Considering the theory presented in this book, I am compelled to envision a fantastic society that had developed a power system thousands of years ago that we can barely imagine today. This society takes shape as we ask the logical question, "How was the energy transmitted? How was it used?" These questions cannot be fully answered by examining the artifacts left behind. However, these artifacts can stimulate our imaginations further; then we are left to speculate on the causes for the demise of the great and intelligent civilization that built the Giza power plant. This speculation is the subject of the remainder of this book.

Chapter Fourteen

A GLIMPSE INTO THE PAST

Our lives are dependent on the switch. How many times do we use the switch in a day? Ever count them? Have you ever followed the wire back to the source, in your mind, and paused in wonderment at the true power you have at your fingertips? How many miles of electrical cable will your mind travel along before it reaches the 500-megawatt turbine generators at the power station? Now think about what life would be like without electricity. Actually, we do not have to go too far back in time to relive that scenario. Every device that uses electricity has been developed within the past one hundred years. We are now so dependent on electricity and the switch that it would be inconceivable to be without them. Some of us will remember when there were no electric lights in our homes, and gaslight and candles provided illumination. To others, such an existence will be beyond comprehension. The electricity that feeds the homes of developed countries is synonymous with shelter and has become as basic a staple as food and clothing. How did we come so far so fast?

Modern electrical power distribution technology is largely the fruit of the labors of two men—Thomas Edison and Nikola Tesla. Compared with Edison, Tesla is relatively unknown, yet he invented the alternating electric current generation and distribution system that supplanted Edison's direct current technology and that is the system currently in use today. Tesla also had a vision of delivering electricity to the world that was revolutionary and unique. If his research had come to fruition, the technological landscape would be entirely different than it is today. Power lines and the insulated towers that carry them over thousands of country and city miles would not distract our view. Tesla believed that by using the electrical potential of the Earth, it would be possible to transmit electricity through the Earth and the atmosphere without using wires. With suitable receiving devices, the

electricity could be used in remote parts of the planet. Along with the transmission of electricity, Tesla proposed a system of global communication, following an inspired realization that, to electricity, the Earth was nothing more than a small, round metal ball. In a letter to *Electrical World and Engineer* magazine, March 5, 1904, Tesla wrote:

> *When the great truth, accidentally revealed and experimentally confirmed is fully recognized, that this planet, with all its appalling immensity, is to electric currents virtually no more than a small metal ball and that by this fact many possibilities, each baffling imagination and of incalculable consequence, are rendered absolutely sure of accomplishment; when the first plant is inaugurated and it is shown that a telegraphic message, almost as secret and non-interferable as a thought, can be transmitted to any terrestrial distance, the sound of the human voice, with all its intonations and inflections, faithfully and instantly reproduced at any other point plying light, heat or motive power, anywhere—on sea, or land, or high in the air—humanity will be like an ant heap stirred up with a stick: See the excitement coming.*[1]

With $150,000 in financial support from J. Pierpont Morgan and other backers, Tesla built a radio transmission tower at Wardenclyffe, Long Island, that promised—along with other less widely popular benefits—to provide communication to people in the far corners of the world who needed no more than a handheld receiver to utilize it.

In 1900, Italian scientist Guglielmo Marconi successfully transmitted the letter "S" from Cornwall, England, to Newfoundland and precluded Tesla's dream of commercial success for transatlantic communication. Because Marconi's equipment was less costly than Tesla's Wardenclyffe tower facility, J. P. Morgan withdrew his support. Moreover, Morgan was not impressed with Tesla's pleas for continuing the research on the wireless transmission of electrical power. Perhaps he and other investors withdrew their support because they were already reaping financial returns from those power systems both in place and under development. After all, it would not have been possible to put a meter on Tesla's technology—so any investor could not charge for the electricity!

Without the support of Morgan, Tesla's other sources for finance dried up

and he became depressed and infirm. He was forced to leave his opulent apartment at the Waldorf Astoria hotel; and his partially manifested dream at Wardenclyffe was torn down and sold for scrap to payoff his debt. As Marconi's stature and fortune rose, Tesla's decline drained his vitality; he passed from this life in a New York hotel room in 1943, leaving a legacy that, even today, still inspires and feeds the intellect of researchers all over the world.

It is distinctly clear that tenuous timing and fickle social circumstances surrounding key inventors and their inventions have shaped our technological landscape. The greatest influence on whether an invention comes to fruition or not is its investors' desire for profit. If Tesla had succeeded before Marconi in achieving transatlantic transmission, would our power delivery systems look like they do today? Perhaps they would if the motivating force behind their construction had been only profit, a profit realized through the metered flow of electricity. It would have been next to impossible to convince investors to give for free what was already reaping handsome rewards. Would such restraints on innovation occur today? Perhaps, but the technology for metering the use of wireless electricity could be accomplished in the same way telephone companies charge for cellular calls. The voice you hear on your cell phone is actually wireless transmitted energy—albeit very little—that is sold to you at a metered rate.

Other, more recent proposals for alternative power delivery also have not been realized on a large scale. The inhabitants of Reykjavik, Iceland, heat their homes and power their processing plants with a natural resource—geothermal energy. Icelanders enjoy year-round benefits in their geothermal heated swimming pools. They have such an abundance of geothermal power that at one time they proposed selling their surplus energy to other countries. Because it would be impractical to build steam pipes across the ocean (not that they even thought of such a folly), an idea was put forward that combined the technology of geothermal energy with some popular suggestions for harnessing solar energy by geosynchronous satellites and transmitting the energy to Earth via microwave beam.

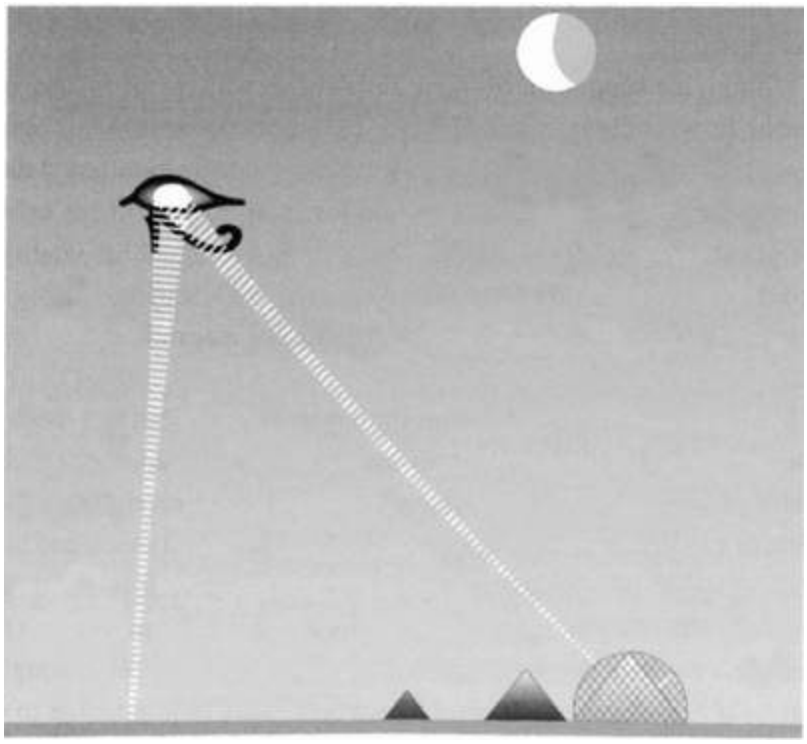


FIGURE 70. ***Egyptian Relay Satellite***

If a satellite could harness solar energy, convert it into electromagnetic energy, and transmit this energy through space to be collected on the Earth, then Earth-based power plants could convert their energy to microwave energy and transmit it into space. A collimated microwave beam could be directed into space to a passive microwave reflector satellite and reflect to a distant point on the Earth (see Figure 70). A microwave beam can pass through clouds and rain with very little attenuation, or loss of energy. A ground-based antenna could then convert it to usable electrical power. It is even possible that a series of satellites could split the energy and deliver it to several points around the globe. Such an energy distribution method is technically feasible, but, like many other proposals for technological innovation, the funding necessary to bring it into physical manifestation is not always immediately forthcoming.

The point of this discussion is that there are many viable energy systems, but those chosen for use are often the ones that make economic, not technological, sense. We must keep in mind, therefore, that what makes sense to us may not have made sense to past cultures. When we try to envision past energy systems we have many layers of cultural blinders to see through. As

we search through the remnants of ancient Egypt looking for the power plants that provided energy to the machine tools that accurately shaped the granite blocks on the Giza Plateau or the granite boxes in the rock tunnels at Saqqara, we cannot assume that their power plants looked like ours or that the infrastructure supporting the distribution of energy was the same. Considering the extremely tenuous circumstances by which inventions are developed, promoted, and utilized, it would be very surprising to find an ancient artifact, or evidence of an artifact, that is identical to one we use or have used in the recent past.

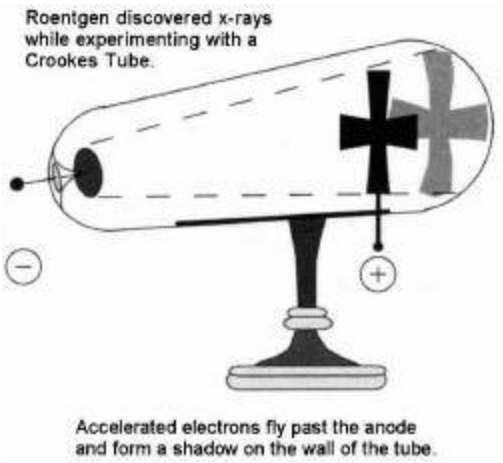

Roentgen discovered x-rays
while experimenting with a
Crookes Tube.
Accelerated electrons fly past the anode
and form a shadow on the wall of the tube.

FIGURE 71. ***Crookes Tube***

This is why I was flabbergasted and stunned when, while looking through a chemistry book one day, I came across an illustration of a Crookes tube (see Figure 71). I had seen such an electrical device before—in photographs taken of an Egyptian temple! The wall carvings at Dendera in the lower crypt in the temple of Hathor contain an image that looks similar to a Crookes tube (see Figure 72).

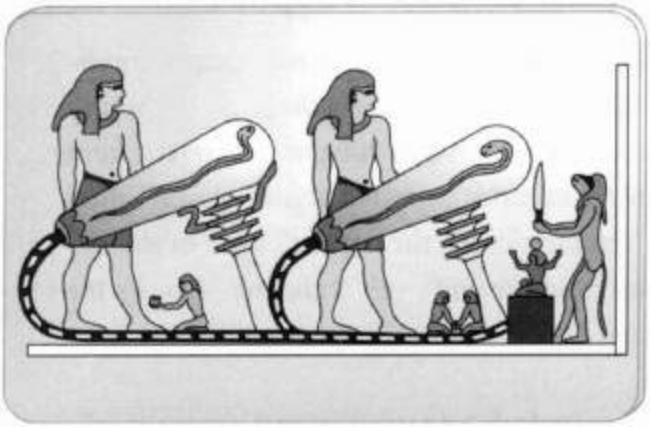


FIGURE 72. ***Wall Carving at Dendera***

Then, while I was working on the final stages of this book, I came across another reference to the wall carving at Dendera and its graphical representation of a Crookes tube in Brad Steiger's book *Worlds Before Our Own.* As I had read this book in 1978, the information probably receded into my subconscious mind and, without a conscious link to this book, resurfaced only after I had actually seen the illustrations many years later. The question of how the ancient Egyptians were able to illuminate the passageways and chambers in their pyramids and tombs has puzzled many people; the walls and ceilings of the tunnels and chambers are not marked with the smut that would accumulate in the use of blazing torches. While pondering this phenomenon, Steiger referred to the research of Joey R. Jochmans who presented an analysis of the wall carvings at Dendera:

> *When the [Crookes] tube is in operation, the ray originates where the cathode electrical wire enters the tube to the opposite end. In the temple picture, the electron beam is represented as an outstretched serpent. The tail of the serpent begins where a cable from the energy box enters the tube, and the serpent's head touches the opposite end. In Egyptian art, the serpent was the symbol of divine energy.*
>
> *. . . The Temple picture shows one tube, on the extreme left of the picture, to be operating under normal conditions. But with the second tube, situated closest to the energy box on the right, an interesting experiment has been portrayed. Michael R. Freeman, an electric and electromagnetic engineer, believes that the solar disc on Horus' head is a Van de Graaff generator, an apparatus which collects static electricity. A*

baboon is portrayed holding a metal knife between the Van de Graaff—solar disc and the second tube. Under actual conditions, the static charge built up on the knife from the generator would cause the electron beam inside the Crookes tube to be diverted from the normal path, because the negative knife and negative beam would repel each other. In the Temple picture, the serpent's head in the second tube is turned away from the end of the tube, repulsed by the knife in the baboon's hand.[2]

Steiger presented another analysis by a professional engineer, who saw the wall carvings at Dendera as an accurate illustration of an electrical device—one which would not be out of place in a modern electrical blueprint file. "In regards to the ancient Egyptian electron tubes, electromagnetic engineer Professor S.R. Harris identified a box-and-braided cable in the picture as 'virtually an exact copy of engineering illustration used today for representing a bundle of conducting wires.' The cable runs from the box the full length of the floor and terminates at both the ends and at the bases of two peculiar objects resting on two pillars. Professor Harris is said to have identified these representations as high voltage insulators."[3]

While technologists compare the image in this wall carving with what they know of science, Egyptologists interpret these images with what they know of ancient Egyptian symbolism. Unorthodox Egyptologist, John Anthony West, is convinced that Egyptian symbolism fully explains these images without having to invoke higher scientific knowledge. According to West, the carvings represent a manifestation of consciousness, with the serpent born aloft by the lotus—symbols representing a cosmogonical principle underlying all creation. As these are only illustrations and not the object they actually represent, different interpretations of what they actually mean may always exist. They are interesting graphics, in light of what is presented in this book, but not an essential part of my theory.

Even though I have solid evidence to support my Giza power plant theory, I am still haunted with questions that challenge this radical notion that the ancient Egyptians had electricity. "What did they do with the energy they produced? Where are the machines?" I often hear these questions when discussing my power plant theory with others. Of course, when we consider a civilization that is blessed with abundant electrical energy, we immediately

think of refrigerators, washers, dryers, and other appliances that have become so necessary to our own comfortable existence. Not being able to identify any museum with a prehistoric toaster oven on display, I generally have responded that once a society develops a power system, it mayor may not go on to invent the kinds of devices to use that power. But with the Crookes tube parallel, we have a hint that at least one of the devices the ancient Egyptians had developed had inspired an artisan to carve its likeness in stone.

The Great Pyramid a power plant. The carving at Dendera an electrical device? Igneous rock at numerous locations throughout Egypt that shows signs of having been precision machined. The evidence is there that the ancient Egyptian civilization was a lot different, and more advanced, than historians have led us to believe. So what did the Egyptians do with the energy they produced? From the exit point of the Southern Shaft of the Great Pyramid, the energy that flowed fulfilled a need for the civilization that invested in its construction. How was this energy delivered to those who used it? Our route to an answer takes us full circle, and we find ourselves starting at the Giza power plant itself.

As evidenced by their ability to lift huge weights, both Edward Leedskalnin and the ancient Egyptians were utilizing technology that we do not possess. Their ability to use gravity against itself and make large masses weightless forecasts the development of new technology which may include vehicles that use very little energy and that, conceivably, could gently break through the Earth's atmosphere, hover indefinitely at any point in space, and then safely return to Earth. A society that is not bound by the effects of gravity is a society that is finally unchained from the primitive wheel (which Egyptologists note the Egyptians did not use) and the wasteful, albeit *so*phisticated, use of fire (such as a jet engine). Such a society would no longer need to burn up the planet. Dare we speculate that the energy that exited the Southern Shaft of the Great Pyramid may have been directed to a point in space where a satellite collected the energy and beamed it to a distant point on Earth? Perhaps that point was within the borders of the mythical Atlantis. Perhaps the use for this energy was even more fantastic than we have ever before dreamed.

Robert Bauval is a man who dares to venture into the land of the fantastic. He has an incredible passion for his work and for the theory he proposed,

with Adrian Gilbert, in *The Orion Mystery*. I first met Bauval in February 1995 when he, along with Graham Hancock and Netherlands Television producer Roel Oostra, knocked on my door at the Movenpick hotel near Giza. They were making a courtesy call to inform me that the following morning, after breakfast, they planned to do some filming with me in the King's Chamber inside the Great Pyramid. I had just completed a long journey and was tired, so after their visit I lay down to rest and replayed the events that had brought me to Egypt.

I had concluded many years ago that the ancient Egyptians left nothing, in their design and construction, to chance. When I saw *The Orion Mystery* in Paul and Ardith Keller's bookstore in Camby, Indiana, and leafed through it for a few minutes, I knew I had to buy it. I was holding in my hands a new and revolutionary theory on the pyramids of Egypt.

The Orion Mystery described the placement of the three major pyramids on the Giza Plateau to be analogous to the belt of the constellation Orion. The Great Pyramid and the Second Pyramid (Khafra's) are in alignment and close in size, and the Third Pyramid (Menkaura's) is smaller and offset from the others, mirroring the spatial relationship of the three stars of Orion's belt. With this revelation, the work of astronomer Virginia Trimble became more valuable. Trimble calculated that the Southern Shaft leading from the King's Chamber, with its angle of 44.5 degrees, was in alignment with Orion's belt. The Pyramid Texts associate Orion with the god of the afterlife, Osiris. Trimble surmised that after death, the king's soul traveled up the Southern Shaft to Orion and the king was reborn as Osiris. As Bauval describes Trimble's and his revelation in a documentary, he was indeed inspired with this relationship, and he carried this inspiration for over twelve years before finally writing about it in his best-selling book in 1994. It was the autumn of 1994 that I read the book and sent a letter to Bauval along with my article "Advanced Machining in Ancient Egypt."

Bauval introduced me to Graham Hancock, who was writing *Fingerprints of the Gods* at the time, and subsequently to Roel Oostra, who invited me to Egypt to participate in a documentary. I believed in Bauval's theory—with the exception that he still maintained the tomb theory. Like him, however, I do not believe the Southern Shaft alignment and the placement of the three Giza pyramids happened by chance. For me, any references in the Pyramid

Texts to the king's soul traveling through the Southern Shaft and rising to Orion are metaphors. I am, therefore, in agreement with Bauval and Gilbert who related the process of interpreting these hieroglyphics as analogous to reading a word processing file in a computer:

> *Anyone who has worked with a computer knows that calling up a file using a word-processing program not compatible with the one being used, means a garbled version of the text appearing on the screen.*
>
> *This is more or less what happened (and in many ways is still happening) with the Pyramid Texts and the pyramids of Egypt. We believe that the wrong program for reading them has been used. We are not talking of the translation from the hieroglyphic language to modern languages; we have the utmost faith in the work of Faulkner and others like him. We are referring specifically to the interpretation put on these texts by Egyptologists. We believe that the proper program or decoder exists and needs to be understood before we can properly decode the Pyramid Texts and extract their real, esoteric meaning.*[4]

Their idea prompted me to consider my own theory in another way. Given the astronomical association and significance of the Southern Shaft, is it possible that the energy produced in the King's Chamber, and which then exited the Southern Shaft, *is* referred to in the Pyramid Texts? Perhaps I had only to apply the correct algorithm to interpret it. I read on in *The Orion Mystery*, noting a recurring metaphor from the Pyramid Texts:

> *'. . . The king is a Star . . . '* [PT 1583]
>
> *'The king is a Star which illuminates the sky . . .'* [PT 362, 1455]
>
> *'. . . The king is a Star brilliant and far-travelling . . . the king appears as a star . . .'* [PT 262]
>
> *'Lo, the king arises as this star which is on the underside of the sky . ..'* [PT 347]
>
> *There can be little doubt that the Pyramid Texts make a clear statement that the dead kings become stars, especially seen in the lower eastern sky. They also tell us that it is the souls of departed kings which become stars:*
>
> *'be a soul as a living star . ..'* [PT 904]

'I am a soul. . . I (am) a star of gold . ..' [PT 886–9]

'O king, you are this Great Star, the companion of Orion, who traverses the sky with Orion, who navigates the Duat with Osiris . . .' [PT 882][5]

What an incredible description of events related to the pyramids' link to the stars. Suddenly I saw a new meaning for this star. Imagine if we had put a vehicle in space, for whatever reason, and were beaming energy to it—for the vehicle's own use or to be returned to some location on Earth. Would that vehicle not appear as a bright star in the night sky? Assuming that the energy beam would have some divergence (it would grow in size) the farther it traveled from its source, then the larger the microwave receiver—the "star"—would have to be. On a clear night, we can see a small satellite as it orbits the Earth. What an incredible view we would have of such a receiver dish (refer to Figure 70). Looked at from an angle, would it appear as an eye in the sky?

And more fantastic still, what if the energy were being used to provide power to a space ship? The microwave energy that was projected from the Southern Shaft to Orion's belt stars may have been delivering more than Khufu's soul to the heavens. The energy, which Robert Bauval describes as Khufu's soul traveling to Orion, may have been his actual person along with an entourage!

If this seems too fantastic a speculation, take a moment to consider how future civilizations might interpret our own account of the Sojourner expedition to Mars. Five thousand years from now they probably would not be able to make sense of it because the media that contains the information would have degraded by then. We are in the same position with respect to the ancient Egyptians as our far future descendants will be to us. The Egyptians left multiple records of this "star" carved in stone. Have they been interpreted correctly? Is the interpretation of the hieroglyph of "king" correct?

In the English language there are different meanings for the word "power." It can mean strength, ability, or authority, as in a leader (king). It can also refer to the energy contained in a battery or delivered to your home through a wire. Is it possible that the Pyramid Texts refer to an environment associated with the production of power that was projected into space? We may never be able to answer this question, but it is one that is worth asking and thinking about.

Our speculations on the relationship between the Giza power plant theory and the interpretation of the Pyramid Texts could go on endlessly. For now, they may seem to be more in the realm of science fiction, but we must keep in mind that some of the technology that exists today, and that has been described in this book, was originally described in works of science fiction many years ago. Space travel, global communication satellites, and handheld remote communication devices were technologies that inspired generations of scientists and engineers during their formative years as they devoured the imaginative yarns spun by science fiction writers.

And we must push our speculations even harder. The interpretation of ancient Egyptian hieroglyphs by Egyptologists presents us with a view of a civilization that placed tremendous emphasis on the afterlife, with the kings and pharaohs being preoccupied with life after death. Since Neanderthal tribes first started to bury their dead, humans have held the belief that there is more to our existence than what our physical senses can detect. Many of us require three-dimensional definitions for the things that surround us, but all of natural phenomena cannot be described in these terms—if they could there would be no more mystery or research.

I am compelled, therefore, to touch on a subject that I have been advised to avoid because it brings an element that is not three-dimensional to my work. Every three-dimensional object we use and enjoy today had its beginnings with some form of inspiration or speculative thought. This inspiration may be characterized differently by different people, but common to all is the fact that creativity transcends what we know as physical "reality." If this book is going to be complete and honest, I cannot ignore the information that came into my hands recently in the form of a small blue paperback entitled *Edgar Cayce on Atlantis.*

My wife, Jeanne, has this book in her library, and she compelled me to read what Edgar Cayce had to say about Atlantis because of the flurry of activity he has generated in Egypt. Edgar Cayce, also known as the sleeping prophet, has influenced powerful people in all walks of life. His research foundation in Virginia Beach, Virginia, is the site of yearly conferences at which both scholars and avant-garde researchers have met to discuss and debate issues pertaining to the long-sought-after Atlantean Hall of Records that Cayce predicted would be found near the Great Sphinx.

The jostling for recognition in the historical record is no different today than it was in 1922 when archaeologist Howard Carter discovered the tomb of King Tutankhamen. Recent discoveries made public by Boris Said and Tom Danley spring from a Cayce follower's lifelong desire to find evidence supporting one of Cayce's prophecies—that there is an Atlantean Hall of Records located near the Sphinx. The follower's name is Joseph Schor, and he funded Said and Danley's sonic tests inside the Great Pyramid and around the Sphinx, as well as the exploration of a deep shaft that was discovered close to the causeway nearby. Dr. Zahi Hawass, the director of the Giza Plateau, facilitated their activities, perhaps hoping for an increase in tourism that would follow such a discovery. Hawass has shown support for the discovery of Cayce's Hall of Records and teased before the camera in a tunnel near the Sphinx with news of what was described as a new chamber, which would be opened on live television. The promotional video was not meant to be released, but it was and Hawass's excited promo was revealed to the public prematurely.

Some readers may think Cayce's psychic speculations have no place in a serious book on Egypt. But in light of the fact that the Cayce foundation funded Egyptologist Mark Lehner in his studies in Egypt in the 1970s—though Lehner ultimately moved away from the foundation and he became a staunch supporter of the orthodox view—I feel justified in discussing Cayce's work and, perhaps, putting it into a different perspective. I should add, though, that I do not include this discussion to endorse Cayce's readings, nor have Cayce's readings held up as support for my theory. This is included because Cayce dealt a great deal with ancient Egypt, and his description of ancient technology while in his altered state cannot be ignored.

Cayce's son, Edgar Evans Cayce, does an admirable job explaining his father's psychic readings, which were produced while Cayce was in trance. A series of readings by Cayce-known collectively as reading number 440—with an engineer, referred to in the reading as "the entity;' describes technologies used in Atlantis and Egypt that have an amazing similarity to the technology described in the Giza power plant theory. These readings described the ancient Atlantean power plants, which on the surface seem far removed from the Egyptian pyramids; however, an interpretation of the readings becomes more meaningful when we compare (what Cayce described as) the "firestone"

with granite, out of which the King's Chamber, the power center in the Giza power plant, is constructed:

About the firestone—the entity's activities then made such applications as dealt both with the constructive as well as destructive forces in that period. It would be well that there be given something of a description of this so that it may be understood better by the entity in the present.

In the center of a building which would today be said to be lined with nonconductive stone—something akin to asbestos, with. . . other nonconductors such as are now being manufactured in England under a name which is well known to many of those who deal in such things. The building above the stone was oval; or a dome, wherein there could be . . . a portion for rolling back, so that the activity of the stars—the concentration of energies that emanate from bodies that are on fire themselves, along with elements that are found and not found in the earth's atmosphere.

The concentration through the prisms of glass (as would be called in the present) was in such manner that it acted upon the instruments which were connected with the various modes of travel through induction methods which made much the [same] character of control as would in the present day be termed remote control through radio vibrations or directions; though the kind of force impelled from the stone acted upon the motivating forces in the crafts themselves.

The building was constructed so that when the dome was rolled back there might be little or no hindrance in the direct application of power to various crafts that were to be impelled through space—whether within the radius of vision or whether directed under water or under other elements, or through other elements.

The preparation of this stone was solely in the hands of the initiates at the time; and the entity was among those who directed the influences of the radiation which arose in the form of rays that were invisible to the eye but acted upon the stones themselves as set in the motivating forces—whether the aircraft were lifted by the gases of the period; or whether for guiding the more-of-pleasure vehicles that might pass along close to the earth, or crafts on the water or under the water.

These, then, were impelled by the concentration of rays from the stone which was centered in the middle of the power station, or powerhouse (as would be the term in the present).

In the active forces of these, the entity brought destructive forces by setting up—in various portions of the land—the kind that was to act in producing powers for the various forms of the people's activities in the cities, the towns and the countries surrounding same. These, not intentionally, were tuned too high; and brought the second period of destructive forces to the people in the land-and broke up the land into those isles which later became the scene of further destructive forces in the land. (440—5; Dec. 20, 1933)[6]

Though Edgar Evans Cayce interprets the reading to mean that when the Atlantean power house was in operation the "firestone" was on fire, or influenced by heat, another more accurate interpretation can be made. The firestone to which Cayce refers is actually an accurate description of igneous rock—or granite (igneous, in this sense, means "produced by or resulting from the action of fire").[7] When I read the word "firestone" in reference to the Atlantean power house, I immediately thought of the King's Chamber's thousands of tons of granite that were prepared by those who would have possessed a higher knowledge of the sciences and arts. The crystal Cayce refers to, however, is contained within the granite itself in the Great Pyramid, in the form of quartz crystals—though there very well may have been an additional solid crystal that was cut and polished to amplify the microwave input signal. The application of Tesla technology using wireless transmission of electricity also is suggested in this passage, although Tesla's Wardencliffe tower research came thirty-three years before Cayce's reading, and one could argue that Cayce may have heard of this research and could have been influenced by it during the reading.

What is interesting about Cayce's reading is his reference to the energy of the stars and the use of these energies in conjunction with the energies he discussed in a reading in 1930: "in city of Peos in Atlantis—among people who gained understanding of application of nightside of life or negative influences in the earth's spheres, of those who gave much understanding to the manner of sound, voice and picture and such to peoples of that period."

(2856–1; June 7,1930)[8]

As I said, I have not been a follower of Cayce. During the early days of the research for this book, I was ignorant of what he had written on the subject. It is only recently that I have maintained a mild interest in what has been reported by him with respect to advanced cultures in prehistory. His description of the power system of the Atlanteans, though, is remarkably similar to what is found within the Great Pyramid. The only thing that does not seem to fit is the shape. Cayce's power plant has a domed structure with the awesome firestone located in the center of the structure. Perhaps the Great Pyramid originally had such a structure. Consider, also, Cayce's statement about the conversion of energy through the firestone. He says the energies were tuned too high and caused widespread destruction. This description certainly gives us pause to consider what changes would take place or what forces could be unwittingly unleashed within the Earth if such a power system was replicated. What unknown changes might we be setting in motion? Would we be faced with annihilation? Would we find ourselves on the threshold of our past?

In this chapter we have asked a lot of questions, only sometimes finding an answer. But our speculations are worthwhile nonetheless. All the evidence found clearly shows that the ancient Egyptians were technologically advanced and that the Great Pyramid provides us with a guidepost, a geodetic marker, that leads us not only to reconsider what we know about past civilizations but also to wonder where our own technology may ultimately lead us. If Cayce's reading has any basis in truth, we are faced with the realization that technology—no matter what the technology is or in what epoch it is developed—can have both positive and negative consequences for the civilizations that pursue its benefits. That is the subject we turn to next.

Chapter Fifteen

LESSONS FROM THE PAST

While in Egypt, I was surprised to learn from an Egyptologist at the Citadel that the outer casing stones of the Great Pyramid were not plundered to construct the mosques of Cairo, as it has been reported, but were eroded by sandstorms over time. I questioned him as to why the Second Pyramid still had its casing stones intact at the top if this was true, but he didn't have an answer. My impression, while walking around the nine-pyramid complex, was that the stones had actually been shaken loose by some event that caused a buildup of vibration to the point that the pyramids became runaway vibrators. The pyramid at Meidum, with its outer casing stripped and piled high around its base, would certainly fit this description of events. The stones on this pyramid were stripped off through the action of forces other than the picks of mosque builders. So which theory is correct? Perhaps the question really is, Which theory is more likely? The evidence can be interpreted many ways. When I look far into the past, I can discern the existence of sciences of which there are no surviving records. They have either been destroyed or complete records never existed. Did science account for the amazing artifacts I had seen throughout Egypt? And did science also explain, at least in part, this culture's demise? When I looked for an event in Egyptian history that would explain the destruction of this culture and at the same time explain the erosion of the pyramids, I found a clue in the 1985 discovery of volcanic ash twenty feet underground in the Nile delta. This ash was found to be identical to that from an enormous eruption that occurred approximately 3,500 years ago on the Greek island of Santorini. The eruption is estimated to have been 22,000 times more destructive than the atomic bomb that was dropped on Hiroshima. Here was a partial answer. However, it was becoming clearer to me that another reason for the destruction of a civilization can be related to its use and/or abuse of the technology it

develops.

It is reasonable to assume that if we were to destroy ourselves through nuclear holocaust, the geological and biological record would bear witness to it and reveal that knowledge to future archaeologists as they became more advanced in their science. At the same time, some of our civil engineering projects might survive, and the occasional archaeological anomaly might turn up to promote some thought in that direction. Perhaps a granite surface plate would be found, and someone would puzzle over the positioning of the holes drilled into it. Who knows, maybe some future "primitive" tribe would see some significance to this plate and make a ritual object out of it.

When we predict the events that might transpire in the future, we can only draw upon our own experiences and how we interpret our ancestors' behavior. Therefore, many of our assumptions may not have any relationship to the truth at all. Our understanding of the past, however, is supported not only by our understanding of human behavior, but also by what the earlier humans have left behind. From archaeological remains, modern humans are constantly evaluating the progress of human development on this planet.

Because of the ample evidence that the ancient Egyptians accomplished enormous engineering feats, especially the mighty pyramids, we can begin to fashion a different picture of their civilization. This picture becomes even clearer when we evaluate the methods they must have used to create some of their stonework: machining methods largely unknown until just before the beginning of the twentieth century, and one that has only recently joined the family of machine tools—ultrasonics. All this evidence commands that we take a closer look at this society we have long thought to be primitive.

And yet there is so much that is missing! So much, in fact, that we have to ask ourselves if it is possible that they had the knowledge and scientific capability to destroy themselves, just as we have today? And did this destruction actually come to pass?

World history records the rise and fall of many empires and, with their endings, the vast destruction of property. It occurred to me that in the case of the earlier Egyptians, the cause of their demise was perhaps a little more catastrophic than any other historically recorded downfall or disaster. How catastrophic? If we look closely at the following evidence, perhaps we will begin to understand what such an event could have been.

We now know that the ancient Eygptians had a higher level of science and technology than what has been previously supposed. We also know that the development of technology and machines that harness and control the forces of nature holds negative—perhaps even catastrophic—consequences to those who do not control or use them wisely. When we consider the development of the atom bomb, nuclear power plants, even the automobile, it is clear that the potential for harm is present with every machine in existence.

But how far did the ancients develop their technology? Some researchers have suggested that civilizations in antiquity had actually developed and used atomic power! On the surface it may sound rather incredible, but then there is so much that has not survived the ancient pyramid builders, it would not be out of order to see what these researchers have to say about it.

Brad Steiger presented a forceful argument that in prehistory nuclear explosions had affected several areas of the Earth. He cited the discovery of fused green glass in deep stratas of the Earth, and in Gabon, Africa, the Euphrates Valley, the Sahara Desert, the Gobi Desert, the Mojave Desert, and Iraq. These vast wastelands of melted sand can be compared with White Sands, New Mexico, where the sands were fused as a result of nuclear bomb testing. Steiger wrote, "Perhaps the most potentially mind-boggling evidence of an advanced prehistoric technology that might have blown its parent-culture away is to be found in those sites which ostensibly bear mute evidence of pre-Genesis nuclear reactions.... At the same time, scientists have found a number of uranium deposits that appear to have been mined or depleted in antiquity."[1]

The Sahara Desert was at one time fertile, not the arid wasteland it is today. Geological and archaeological evidence shows that this 3.3-millionsquare-mile tract of land once received ample rainfall, and the rock paintings found in the Tassili N'Ajjer Mountains show that antelopes, elephants, and many other types of animals once occupied the previously lush area. For unknown reasons, the rainfall pattern shifted, and the subsequent imbalance between rainfall and the rate of evaporation (the rain was dried up by the sun faster than it fell from the clouds) turned the area into a desert.

Since vast regions of the globe still remain unexplored, it is impossible to say how many glassy areas there are just in the Sahara. If we are looking for areas where tremendous heat influenced terrestrial characteristics—like the

heat that could be produced by nuclear forces—we have to only look in the previously mentioned deserts. Although these may not in themselves "prove" that prehistoric nuclear war had created them, there are many people who believe this was the case.

If our world were affected by a cataclysmic event—such as a polar displacement, comet strike, or self-inflicted nuclear war—after 10,000 years future generations would have few clues about the level of sophistication we had achieved. It would be fair to say that many of our artifacts would be misinterpreted and misunderstood. What would remain of the "concrete jungles" we call cities? Would they reveal to future archaeologists the full scope of our technological achievements? Future civilizations would be busy developing their own technology. Their development might be along a completely different path than ours has followed, and in its early stages it would not be as advanced. At what stage in their evolution would future archaeologists recognize a computer chip for what it really is?

The artifacts that survived thousands of years following the demise of a highly developed civilization would, in large part, depend on the level of technology that had been achieved. After the ravages of time, many of our artifacts will have crumbled into dust. If future archaeologists are able to analyze and interpret surviving artifacts correctly, some of our plastics and high-tech exotic alloys may provide clues that form a rather rough sketch of the life we now enjoy. It is safe to say, though, that any high-tech artifacts under study by a future generation will be misinterpreted until the technology needed to correctly identify them has been redeveloped.

But clues to what happened to us could be discerned from sources other than humanmade objects. Nature would retain the imprint of a nuclear holocaust. For example, the release of neutrons would sharply increase the amount of carbon 14 in the atmosphere, and it would show up in biological remains, like wood, bone, and other organic material from that period of time. C_{14} is created when the reaction of cosmic rays with the ionosphere precipitates neutrons through the atmosphere. These neutrons react with nitrogen 14, creating C_{14}. Immediately upon its creation, C_{14} starts to decay. Originallyitwas determined to have a half-life of approximately 5,568 years. (The half-life of radiocarbon was redefined from 5570 ± 30 years to 5730 ±

40 years in 1962.) Organic material takes in C_{14} at a constant rate, and, knowing what the level of *C* in an object was before it died, scientists can measure the amount left in it and calculate its age. Apart from normal variations, C_{14} stays at a constant level in the Earth's atmosphere. However, modern nuclear activities have increased the level of C_{14} in the atmosphere, and subsequently in everything that lives and breathes.

When Willard F. Libby first discovered radiocarbon dating in 1947, archaeologists, and especially Egyptologists, ignored it. They questioned its reliability, as it did not coincide with the "known" historical dates of the artifacts being tested. David Wilson, author of *The New Archaeology,* wrote, "Some archaeologists refused to accept radiocarbon dating. The attitude of the majority, probably, in the early days of the new technique was summed up by Professor Jo Brew, Director of the Peabody Museum at Harvard. 'If a C_{14} date supports our theories, we put it in the main text. If it does not entirely contradict them, we put it in a footnote. And if it is completely out-of-date we just drop it.' "[2]

The radiocarbon time scale contains other uncertainties, and errors as great as 2,000 to 5,000 years may occur. Contamination of the artifact may be caused by percolating groundwater, incorporation of older or younger carbon, and contamination in the field or laboratory. Willard Libby[3] addressed the problem of contamination, and the ability to distinguish between the chemistries of life and death (the chemistries of death being the contamination). Washing techniques were then developed to separate the two.

Egyptologists have generally agreed on the dates that had been established for the time of the pharaohs. Consequently, when radiocarbon dating came back with results showing artifacts to be between two hundred and five hundred years younger than their established historical dates, the experts were not impressed. In other words, articles with a "known" date of 5,000 years were tested and, according to radiocarbon dating, were found to be only 4,500 years old. For instance, some of the wood that was found in King Tutankhamen's tomb, historically dated at around 1350 B.C., gave a C_{14} reading of 1050 B.C.

The further back into history the C_{14} researchers went, the larger the

discrepancies became. The original assumption on which C_{14} dating was based was that its level in the atmosphere is the same at all times. Egyptologists and the carbon-dating scientists were, therefore, in contradiction with each other. The Egyptologists and the archaeologists would not budge, and so the scientists were forced to reevaluate their findings, and they searched for an accurate method of calibrating C_{14} to validate its usefulness as an archaeological tool. Until that was accomplished, doubt prevailed.

The answer came in the form of tree-ring dating, and the tree that eventually provided the means to accomplish this accurate C_{14} dating was the bristlecone pine, indigenous to the southwestern United States. As the oldest living tree on Earth, the bristlecone pine enabled scientists to develop the chronology to calibrate carbon dating and "adjust the clock." The results are noteworthy. It turned out that the Egyptologists and the archaeologists were correct in their dates and the original C_{14} results were in error. In some cases, for distant dates, the error was as much as eight hundred years. But this finding had more than one interpretation: The Egyptologists may be correct in their historical timeline; or there may have been an unexplained "infusion" of C_{14} into the atmosphere at some prehistoric time. David Wilson summed up the argument this way: "If present day measurements of the radiocarbon remaining in objects which died in, say, 2,500 B.C. give a date of 2,000 B.C., then there is 'too much' carbon 14 left undecayed—perhaps it is that there was 'too much' carbon 14 in the object originally in 2,500 B.C. This is now generally accepted as being the case, but that still leaves the question open as to why there was more carbon 14 in the atmosphere and biosphere."[4] The question is still open, although scientists have speculated that if the latter scenario is true-there was more C_{14} in the ancient atmosphere than they would expect—the answer might be that variations in the Earth's magnetic field allowed increased amounts of cosmic rays to react with the ionosphere.

When carbon dating was first being developed, organic samples were collected for testing from around the world. The stipulation on the kind of samples that were collected was that they had died and ceased to draw carbon in from the atmosphere before the advent of our industrial age, and especially before nuclear testing had been carried out. The explosion of nuclear devices

releases neutrons that would result in an elevation of C_{14} in the atmosphere. Tree-ring dating had revealed that there was an elevation of C_{14} in the atmosphere and in artifacts older than 1,000 B.C., which had thrown off the atomic clock. Around 8,000 B.C. to 10,000B.C., the level of C_{14} started to fall back to "normal."

What we are forced to consider is whether the high level of C_{14} in prehistoric artifacts is a "smoking gun" left behind by a highly evolved civilization 10,000 years ago. As I have argued, a complete interpretation of a civilization such as ours is beyond the scope of one individual or group of individuals who are trained in only one discipline. Archaeologists and Egyptologists have interpreted and explained artifacts surviving ancient civilizations from a perspective that has resulted in a belief that our own civilization is the first to develop technology that uses electricity as a means of performing work. Working from this premise, it is not surprising that evidence such as the granite artifacts found in Egypt, which demand that we include the possibility of advanced technological knowledge existing in prehistory, has been misinterpreted, disregarded, or overlooked.

We also must consider, however, that if this unthinkable nuclear catastrophe actually transpired, someone would have put into writing the horror they witnessed. It is possible that such writings would survive the centuries to provide future historians with some clues to the horrific events, assuming those records were interpreted correctly. Without doubt, an event of such magnitude would leave its mark. And indeed, written records do entice us with clues of what could have been an ancient nuclear accident—or even an ancient nuclear war.

The ancient Indian Sanskrit text *The Mahābhārata* is a work that has no precise chronological origin. It is estimated that it was written around 400 B.C. but probably was copied from earlier texts from a much earlier date. A complete translation in eleven volumes, though unelegant in some scholars' minds, was made by Kesari Mohan Ganguli and published under the name P. Chandra Roy between 1883 and 1896.[5] The work is replete with references to terrible wars that involved the use of weapons that we normally do not associate with the primitive warriors ofprehistory. The writer, or writers, of *The Mahābhārata* seemed to exaggerate, or get confused, when describing

weapons that—given the era in which they were used—should have been limited to swords, spears, and bows and arrows. Was it imagination or wishful thinking that prompted the writer(s) to describe weapons that included missiles and "birds" that swooped down from the heavens, issuing forth fire to demolish entire forests? There also was a terrifying device that moved in a way that, if considered to be a simple projectile, defied the laws of physics:

> *Thus the terrifying tumult of war was rampant when the Gods Nara and Nārāyana joined the battle. The blessed Lord Visnu, upon seeing the divine bow in Nara's hand, called up with his mind his Dānavadestroying discus. No sooner thought-of than the enemy-burning discus appeared from the sky in a blaze of light matching the sun's, with its razor-sharp circular edge, the discus Sudarsana, terrible, invincible, supreme. And when the fiercely blazing, terror-spreading weapon had come to hand, God Acyuta [Visnu] with arms like elephant trunks loosed it, and it zigzagged fast as a flash in a blur of light, razing the enemy's strongholds. Effulgent like the Fire of Doomsday, it felled foe after foe, impetuously tearing asunder thousands of Dānavas and Daityas as the hand of the greatest of men let go of it in the battle. Here it was ablaze licking like a fire, there it cut down with a vehemence the forces of the Asuras. How it was hurled into the sky, then into the ground, and like a ghoul it drank blood in that war.*[6]

There seem to be forces at work in this battle that we do not possess even today. There is an intelligence that guides this discus. Is this intelligence just the imagination of the writer, or is it the report of an eyewitness observation? In order to justify the latter, we have to consider not only the intelligence that guided this discus, but the source of its energy. As though to answer our question, the text later refers to the "Elixir" that brought an added dimension to the ancient Indian wars so that they more closely parallel our own: "When that grand bird had rid them all of life, he strode across them to look for the Elixir. He saw fire everywhere; blazing fiercely, it filled all the skies with its flames, burning hot and razor-sharp rays, and evil under the stirring of the wind."[7] Then as if to make an association between the Elixir and its use: "He saw, in front of the Elixir, an iron wheel with a honed edge and sharp blades,

which ran incessantly, bright like fire and sun. . . . And behind the wheel he saw two big snakes, shimmering like blazing fires, tongues darting like lightning, mouths blazing, eyes burning, looks venomous, no less powerful than gruesome, in a perpetual rage and fierce, that stood guard over the Elixir, their eyes ever-baleful and never blinking. Whomever either snake's eyes were to fall upon would turn to ashes."[8] This passage brings to mind the important role gasoline has played in modern war, not only as a weapon, but as fuel for vehicles. Could the Elixir have been the gasoline that fueled these ancient conflagrations?

Perhaps the foregoing is just an ancient myth that has no basis in reality, although there are more references to other weapons of war that are closer to home and that have more meaning today than they did when the Sanskrit was first translated: "The King of the Gods, beholding the rage of Phalguna, unleashed his own blazing missile, which streaked across the entire sky. Thereupon the Wind God, who dwells in the sky, thunderously shaking all the oceans, generated towering clouds that sent forth shafts of water."[9]

With missiles streaking through the air against an opposing force, it may not be so surprising to find that the ancient Indians used these missiles in much the same way as the United States in the Gulf War with the Patriot missile: ". . . Filled with anger and vindictiveness, Parasurama brought forth a mighty weapon of Brahmā. On my part, I produced the same excellent weapon of Brahmā in order to counter the effect of his weapon. Those two weapons of Brahmā met each other in mid-air, without being able to reach either Rama or myself. Around them a flame blazed forth, and living things were greatly afflicted thereby."[10] As though to indicate the power of these mighty missiles, the ancient storyteller(s) wrote, "Thus sped by that mighty warrior, the shaft endowed with the energy of the Sun caused all the points of the compass to blaze with light."[11]

Knowing that the energy of the sun comes from the fusion of hydrogen atoms, the thought of hydrogen bombs brings terrible visions of vast destruction, mushroom clouds, and insidious radiation wafting across the land. These visions are included in other books that reference *The Mahābhārata* as testimony of nuclear war in prehistory. In *We Are Not the First*, Andrew Tomas wrote: "'A blazing missile possessed of the radiance of

smokeless fire was discharged. A thick gloom suddenly encompassed the heavens. Clouds roared into the higher air, showering blood. The world, scorched by the heat of that weapon, seemed to be in fever: thus describes the *Drona Parva* a page of the unknown past of mankind. One can almost visualize the mushroom cloud of an atomic bomb explosion and atomic radiation. Another passage compares the detonation with a flare-up of *ten thousand suns."*[12]

Frederick Soddy, British chemist and Nobel prize winner for his work on the origin and nature of isotopes, discerned a vastly different meaning in these words than his contemporaries. Regarding the ancient Indian scriptures in 1909, before the atomic age, he wrote: "Can we not read into them some justification for the belief that some former forgotten race of men attained not only to the knowledge we have so recently won, but also the power that is not yet ours?"[13] Soddy's work with British phycisist Ernest Rutherford added to our understanding of the atom and led to the splitting of its nucleus by Sir John D. Cockroft and Ernest T. Walton in 1932. Soddy believed that civilizations in the past were familiar with the awesome power contained within the atom and had suffered the consequences of its misuse. In 1910 he wrote in his book, *Radium:*

> *Some of the beliefs and legends bequeathed to us by antiquity are so universal and firmly established that we have become accustomed to consider them as being almost as ancient as humanity itself. Nevertheless, we are tempted to inquire how far the fact that some of these beliefs and legends have so many features in common is due to chance, and whether the similarity between them may not point to the existence of an ancient, totally unknown and unsuspected civilization of which all other traces have disappeared.*[14]

Tomas pointed out that a skeleton was discovered in India that had up to fifty times more radioactivity than normal. He also puzzled over a meeting he had with Pundit Kaniah Yogi. He wrote:

> *According to Pundit Kaniah Yogi of Ambattur, Madras, whom I met in India in 1996, the original time measurement of the Brahmins was*

sexagesimal, and he quoted the Brihath Sathaka and other Sanskrit sources. In ancient times the day was divided into 60 kala, each equal to 24 minutes, subdivided into 60 vikala, each equal to 24 seconds. Then followed a further sixty-fold subdivision of time into para tatpara, vitatpara, ima and finally kashta—or 1/300,000,000 of a second. The Hindus have never been in a hurry and one wonders what use the Brahmins made of these fractions of a microsecond. While in India the author was told that the learned Brahmins were obliged to preserve this tradition from hoary antiquity but they themselves did not understand it.

Is this reckoning of time a folk memory from a highly technological civilization? Without sensitive instruments the kashta would be absolutely meaningless. It is significant that the kashta, or 3 Ã— 10^{8} second, is very close to the life-spans of certain mesons and hyperons. This fact supports the bold hypothesis that the science of nuclear physics is not new.

The Varahamira Table*, dated B.C. 550, indicates even the size of the atom. The mathematical figure is fairly comparable with the actual size of the hydrogen atom.*[15]

The indications that nuclear war was once a reality on this planet and was suffered by a civilization that was equally advanced as or more advanced than our own may be supported by some and rejected by others. However, we can no longer ignore the factual evidence that a prehistoric civilization capable of developing advanced machining techniques once existed on this planet. The theory I have presented in this book is based purely on fact, and I trust that readers will evaluate the deductions I have drawn from these facts with open-mindedness and objectivity.

That said, I would like now to revisit one of those deductions, the one that suggests the Egyptians understood the properties of gravity. It has been speculated on more than one occasion, and by more than one person, that this ancient civilization had the technology to neutralize the effects of gravity. If this were true, then the technological tools Egyptologists look for as evidence that the Egyptians were not primitive, such as the wheel or specific machinery, might have never existed—because the Egyptians would not have needed them! The simple fact is that the tools and machines we find so necessary in our gravity-bound civilization would not have been needed in a

society that was able to control gravity.

If we were to develop the technology to overcome gravity, the energy expenditure of the peoples of the world would be sharply curtailed. Along with our diminished need for energy, we would no longer require many other ancillary products of an advanced society. Huge oil refineries, tire manufacturers, large manufacturing plants churning out massive engines and vehicle transmissions, and hundreds of thousands of miles of highways would conceivably become obsolete.

The point I am trying to make is that when we study the past seeking evidence of a highly advanced culture, we should not expect to find objects that we associate with our own culture. Different cultures develop along different paths. This process occurs even over relatively short periods of time, especially when one society is isolated from others. For example, when the Allies went into Germany after Hitler's defeat, they found that after only twelve years of isolation German technology was being developed along lines vastly different from our own. Pauwels and Bergier wrote:

> *When the War in Europe ended on May 8th, 1945, missions of investigation were immediately sent out to visit Germany after her defeat. Their reports have been published; the catalogue alone has 300 pages. Germany had only been separated from the world since 1933. In twelve years the technical evolution of the Reich developed along strangely divergent lines. Although the Germans were behindhand as regards the atomic bomb, they had perfected giant rockets unmatched by any in America or Russia. They may not have had radar, but they had perfected a system of infra-red ray detectors which were quite as effective. Though they did not invent silicones, they had developed an entirely new organic chemistry, based on the eight-ring carbon chain.*
>
> *. . . They had rejected the theory of relativity and tended to neglect the quantum theory. ... they believed in the existence of eternal ice and that the planets and the stars were blocks of ice floating in space. If it has been possible for such wide divergencies to develop in the space of twelve years in our modern world, in spite of the exchange of ideas and mass communications, what view must one take of the civilizations of the past? To what extent are our archaeologists qualified to judge the state of the*

sciences, techniques, philosophy and knowledge that distinguished, say, the Maya or Khmer civilizations?[16]

The distance between our civilization and the one that built the pyramids obviously is far greater than that which separated us from Hitler's Germany. Still, we seem compelled to explain everything, even prehistoric cultures, in terms of our own knowledge and experience. We are seldom satisfied with an incomplete picture of the subject we are studying, and so taking fragments from here and there, we tend to fill in the gaps using deductive reasoning. Deductions, however, are contradictory, so we must scrutinize the facts from which they are drawn, not picking and choosing only those that help our case, but including all the evidence, no matter how discomforting to our beliefs.

My theory is that the Great Pyramid was the ancient Egyptians' power plant. However radical the idea may seem, it is, in my mind, supported by hard archaeological evidence. The artifacts reveal that the ancient Egyptians used advanced machining methods, which supports the deduction that their civilization, and perhaps others, was technologically advanced. Nevertheless, even with the powerful evidence I have presented throughout this book, and the growing support for such ideas, there is still a mountain of evidence—or lack of it—that prevents this theory's total acceptance. I acknowledge this truth, and I am open to revising my power plant theory if another theory presents itself to explain all the anomalies in the ancient artifacts and pyramids I have examined to build my own case.

The knowledge needed to evaluate certain of these ancient artifacts was not available until very recently. Even today there may be numerous articles that we will not understand until we further develop our own technology. We cannot fathom technology that is unknown to us, and we seldom consider things that seem impossible to us. Petrie, though knowledgeable in engineering and surveying, could not be expected to know anything about ultrasonic machining; hence his amazement at the machining abilities of the ancient Egyptians. Even if he had been aware of this technology, the intellectual climate of his time may have precluded his considering the possibility that these methods were known to the ancient Egyptians. Quite simply, the greatest barrier to our understanding may not necessarily be knowledge. It may be attitude.

One of the most inconceivable events with which modern humans are faced is nuclear disaster. Though the threat of all-out nuclear war between the United States and the former Soviet Union has been greatly reduced, it is still possible that our civilization could be wiped from the face of the Earth by a few miscalculations in foreign policy, a reckless terrorist act, or an error or malfunction in our own nuclear weapons or devices—the ones supposedly protecting us from a premature reaction to a nonexistent threat. Could it happen? Most of us believe that we, as a species, are simply too smart for these possibilities to overtake us.

Has it happened before? Were the ancient Egyptians smart enough to ensure that their own civilization would endure? The greatest lessons regarding our own mortality may begin with the pyramids of Egypt, the strong evidence of advanced machining practiced by the ancient Egyptians, the geological and biological records, and the world's ancient sacred records—these are all pieces of a giant puzzle that so many of us are trying to piece together. I have hope that we will regain this lost knowledge and learn from the lessons of the far distant past in time to save our own society from the fate that likely befell advanced civilizations that came before us. And I hope that along with granting us the wisdom to survive, this knowledge also may provide us the means through which we can evolve—spiritually, intellectually, and technologically—into more than we have ever chanced to dream.

Appendix A

THE MECHANICAL METHODS OF THE PYRAMID BUILDERS

by
Sir William Flinders Petrie

From *Pyramids and Temples of Gizeh,* 74–78.

Author's Note: These pages from Petrie are reproduced exactly from the original, including punctuation style. I have included this Appendix so that the reader will better understand the context within which Petrie presents his evidence.

The methods employed by the Egyptians in cutting the hard stones which they so frequently worked, have long remained undetermined. Various suggestions have been made, some very impracticable; but no actual proofs of the tools employed, or the manner of using them, have been obtained. From the examples of work which I was able to collect at Gizeh, and from various fixed objects of which I took casts, the solution of the questions so often asked seems now to have been found.

The typical methods of working hard stones—such as granite, diorite, basalt, etc.—was by means of bronze tools; these were set with cutting points, far harder than the quartz which was operated on. The material of these cutting points is yet undetermined; but only five substances are possible —beryl, topaz, chrysoberyl, corundum or sapphire and diamond. The character of the work would certainly seem to point to diamond as being the cutting jewel; and only the consideration of its rarity in general, and its absence from Egypt, interfere with this conclusion, and render the tough

uncrystallized corundum the more likely material.

Many nations, both savage and civilized, are in the habit of cutting hard materials by means of a soft substance (as copper, wood, horn, etc.), with a hard powder supplied to it ; the powder sticks in the basis employed, and this being scraped over the stone to be cut, so wears it away. Many persons have therefore readily assumed (as I myself did at first) that this method must necessarily have been used by the Egyptians; and that it would suffice to produce all the examples now collected. Such, however, is far from being the case; though no doubt in alabaster, and other soft stones, this method was employed.

That the Egyptians were acquainted with a cutting jewel far harder than quartz, and that they used this jewel as a sharp pointed graver, is put beyond doubt by the diorite bowls with inscriptions of the fourth dynasty, of which I found fragments at Gizeh; as well as the scratches on polished granite of Ptolemaic age at San. The hieroglyphs are incised, with a very free-cutting point; they are not scraped nor ground out, but are ploughed through the diorite, with rough edges to the line. As the lines are only 1/150 inch wide (the figures being about .2 long), it is evident that the cutting point must have been harder than quartz; and tough enough not to splinter when so fine an edge was being employed, probably only 1/200 inch wide. Parallel lines are graved only 1/30 inch apart from centre to centre.

We therefore need have no hesitation in allowing that the graving out of lines in hard stones by jewel points, was a well known art. And when we find on the surfaces of the saw-cuts in diorite, grooves as deep as 1/100 inch, it appears far more likely that such were produced by the jewel points in the saw than by any fortuitous rubbing about of a loose powder. And when, further, it is seen that these deep grooves are almost always regular and uniform in depth, and equidistant, their production by the successive cuts of the jewel teeth of a saw appears to be beyond question. The best examples of equidistance are the specimens of basalt No.4, (Pl. viii.), and of diorite No. 12 ; in these the fluctuations are no more than such as always occur in the use of a saw by hand-power, whether worked in wood or in soft stone.

On the granite core, broken from a drill hole (No.7), other features appear, which can only be explained by the use of fixed jewel points. Firstly, the grooves which run around it form a regular spiral, with no more interruption

or waviness than is necessarily produced by the variations in the component crystals ; this spiral is truly symmetrical with the axis of the core. In one part a groove can be traced, with scarcely an interruption, for a length of four turns. Secondly, the grooves are as deep in the quartz as in the adjacent feldspar, and even rather deeper. If these were in any way produced by loose powder, they would be shallower in the harder substance—quartz; whereas a fixed jewel point would be compelled to plough to the same depth in all the components; and further, inasmuch as the quartz stands out slightly beyond the feldspar (owing to the latter being worn by general rubbing), the groove was left even less in depth on the feldspar than on the quartz. Thus, even if specimens with similarly deep grooves would be produced by a loose powder, the special features of this core would still show that fixed cutting points were the means here employed.

That the blades of the saws were of bronze, we know from the green staining on the sides of saw cuts, and on grains of sand left in a saw cut.

The forms of tools were straight saws, circular saws, tubular drills, and lathes.

The straight saws varied from .03 to .2 inch thick, according to the work; the largest were 8 feet or more in length, as the cuts run lengthways on the Great Pyramid coffer, which is 7 feet 6 in. long. The examples of saw cuts figured in Pl. viii. are as follow. No.1, from the end of the Great Pyramid coffer of granite, showing where the saw cut was run too deep in the stuff twice over, and backed out again. No.2, a piece of syenite, picked up at Memphis; showing cuts on four faces of it, and the breadth of the saw by a cut across the top of it. This probably was a waste piece from cutting out a statue in the rough. No.3, a piece of basalt, showing a cut run askew, and abandoned, with the sawing dust and sand left in it ; a fragment from the sawing of the great basalt pavement on the East of the Great Pyramid. No.4, another piece from the same pavement, showing regular and well-defined lines. No.5, a slice of basalt from the same place, sawn on both sides and nearly sawn in two. No.6, a slice of diorite bearing equidistant and regular grooves of circular arcs, parallel to one another ; these grooves have been nearly polished out by cross grinding, but still are visible. The only feasible explanation of this piece is that it was produced by a circular saw. The main examples of sawing at Gizeh are the blocks of the great basalt pavement, and

the coffers of the Great, Second, and Third Pyramids,—the latter, unhappily, now lost.

Next the Egyptians adapted their sawing principle into a circular, instead of a rectilinear form, curving the blade round into a tube, which drilled out a circular groove by its rotation; thus, by breaking away the cores left in the middle of such grooves, they were able to hollow out large holes with minimum of labour. These tubular drills vary from 1/4 inch to 5 inches in diameter, and from 1/30 to 1/5 thick. The smallest hole yet found in granite is 2 inches diameter, all the lesser holes being in limestone or alabaster, which was probably worked merely with tube and sand. A peculiar feature of these cores is that they are always tapered, and the holes are always enlarged towards the top. In the soft stones cut merely with loose powder, such a result would naturally be produced simply by the dead weight on the drill head, which forced it into the stone, not being truly balanced, and so always pulling the drill over to one side; as it rotates, this would grind off material from the core and the hole. But in the granite core, No.7, such an explanation is insufficient, since the deep cutting grooves are scored out quite as strongly in the tapered end as elsewhere ; and if the taper was merely produced by rubbing of powder, they would have been polished away, and certainly could not be equally deep in quartz as in feldspar. Hence we are driven to the conclusion that auxiliary cutting points were inserted along the side, as well as around the edges of the tube drill; as no granite or diorite cores are known under two inches diameter, there would be no impossibility in setting such stones, working either through a hole in the opposite side of the drill, or by setting a stone in a hole cut through the drill, and leaving it to project both inside and outside the tube. Then a preponderance of the top weight to any side would tilt the drill so as to wear down the groove wider and wider, and thus enable the drill and the dust to be the more easily withdrawn from the groove. The examples of tube drilling on PI, viii. are as follow:—No.7, core in granite, found at Gizeh. No.8, section of cast of a pivot hole in a lintel of the granite temple at Gizeh ; here the core being of tough hornblende, could not be entirely broken out, and remains to a length of .8 inch. No.9, alabaster mortar, broken in course of manufacture, showing the core in place ; found at Kom Ahmar (lat. 28°5'), by Prof. Sayee, who kindly gave it to me to illustrate this subject. No. 10, the smallest core yet known, in alabaster; this I owe to

Dr. Grant Bey, who found it with others at Memphis. No. 11, marble eye for inlaying, with two tube-drill holes, one within the other; showing the thickness of the small drills. No. 12, part of the side of a drill-hole in diorite, from Gizeh, remarkable for the depth and regularity of the grooves in it. No. 13, piece of limestone from Gizeh, showing how closely the holes were placed together in removing material by drilling; the angle of junction shows that the groove of one hole just overlapped the groove of another, probably without touching the core of the adjacent hole; thus the minimum of labour was required. The examples of tube drilling on a large scale are the great granite coffers, which were hollowed out by cutting rows of tube drill-holes just meeting, and then breaking out the cores and intermediate pieces; the traces of this work may be seen in the inside of the Great Pyramid coffer, where two drill-holes have been run too deeply into the sides; and on a fragment of a granite coffer with a similar error of work on it, which I picked up at Gizeh. At El Bersheh (lat. 27°42') there is still a larger example, where a platform of limestone rock has been dressed down, by cutting it away with tube drills about 18 inches diameter; the circular grooves occasionally intersecting, prove that it was done merely to remove the rock.

The principle of rotating the tool was, for smaller objects, abandoned in favour of rotating the work; and the lathe appears to have been as familiar an instrument in the fourth dynasty, as it is in modern workshops. The diorite bowls and vases of the Old Kingdom are frequently met with, and show great technical skill. One piece found at Gizeh, No. 14, shows that the method employed was true turning, and not any process of grinding, since the bowl has been knocked off its centring, recentred imperfectly, and the old turning not quite turned out; thus there are two surfaces belonging to different centrings, and meeting in a cusp. Such an appearance could not be produced by any grinding or rubbing process which pressed on the surface. Another detail is shown by fragment No. 15 ; here the curves of the bowl are spherical, and must have therefore been cut by a tool sweeping an arc from a fixed centre while the bowl rotated. This centre or hinging of the tool was in the apex of the lathe for the general surface of the bowl, right up to the edge of it ; but as a lip was wanted, the centring of the tool was shifted, but with exactly the same radius of its arc, and a fresh cut made to leave a lip to the bowl. That this was certainly not a chance result of hand-work is shown, not

only by the exact circularity of the curves, and their equality, but also by the cusp left where they meet. This has not been at all rounded off, as would certainly be the case in hand-work, and it is clear proof of the rigid mechanical method of striking curves.

Hand graving tools were also used for working on the irregular surfaces of statuary; as may well be seen on the diorite statue of Khafra found at Gizeh, and now at Bulak.

The amount of pressure, shown by the rapidity with which the drills and saws pierced through the hard stones, is very surprising; probably a load of at least a ton or two was placed on the 4-inch drills cutting in granite. On the granite core, No.7, the spiral of the cut sinks .l inch in the circumference of 6 inches, or 1 in 60, a rate of ploughing out the quartz and feldspar which is astonishing. Yet these grooves cannot be due to the mere scratching produced in withdrawing the drill, as has been suggested, since there would be about 1/10 inch thick of dust between the drill and the core at that part; thus there could scarcely be any pressure applied sideways, and the point of contact of the drill and granite could not travel around the granite however the drill might be turned about. Hence these rapid spiral grooves cannot be ascribed to anything but the descent of the drill into the granite under enormous pressure; unless, indeed, we supposed a separate rymering tool to have been employed alternately with the drill for enlarging the groove, for which there is no adequate evidence.

That no remains of these saws or tubular drills have yet been found is to be expected, since we have not yet found even waste specimens of work to a tenth of the amount that a single tool would produce; and the tool, instead of being thrown away like the waste, would be most carefully guarded. Again, even of common masons' chisels, there are probably not a dozen known; and yet they would be far commoner than jeweled tools, and more likely to be lost, or to be buried with the workman. The great saws and drills of the Pyramid workers would be royal property, and would, perhaps, cost a man his life if he lost one ; while the bronze would be remelted, and the jewels reset, when the tools became worn, so that no worn-out tool would be thrown away.

Appendix B

WROUGHT IRON FOUND IN THE GREAT PYRAMID

Was copper the only metal available to the ancient Egyptians? Notwithstanding the fact that cutting granite with copper chisels is an impossibility, Egyptologists have asserted that the pyramid builders predated the Bronze Age, and, therefore, were limited in their choice of metals with which to make their tools. Therefore, they say that copper was the only metal that the ancient Egyptians used to fashion the stones with which they built the Great Pyramid. They say this while evidence of prehistoric iron—proving that the ancient Egyptians had developed and used it when building the Great Pyramid—is in the keeping of the British Museum. The discoverers of this piece of iron go to great lengths to argue for and document its authenticity, as John and Morton Edgar point out in their book *Great Pyramid Passages:*

> *It is significant to note, in this connection, that a piece of wrought-iron was found in the Great Pyramid by one of Col. Howard Vyse's assistants, Mr. J.R. Hill, during the operations carried out at Giza in 1837. Mr. Hill found it embedded in the cement in an inner joint, while removing some of the masonry preparatory to clearing the southern air-channel of the King's Chamber. This piece of iron is probably the oldest specimen in existence; and Col. Howard Vyse was fully recognizant of the importance of the find. He forwarded it to the British Museum with the following certificates:*
>
> *'This is to certify that the piece of iron found by me near the (outside) mouth of the air passage, in the southern side of the Great Pyramid at Giza, on Friday, May 26th, was taken out by me from an inner joint, after having removed by blasting the outer two tiers of the stones of the present*

surface of the pyramid; and that no joint or opening of any sort was connected with the above-mentioned joint, by which the iron could have been placed in it after the original building of the Pyramid. I also showed the exact spot to Mr. Perring, on Saturday, June 24th.—J. R. Hill'

'To the above certificate of Mr. Hill, I can add, that since I saw the spot at the commencement of blasting, there have been two tiers of stone removed, and that, if the piece of iron was found in the joint, pointed out to me by Mr. Hill, and which was covered by a larger stone partly remaining, it is impossible it could have been placed there since the building of the pyramid.—J. S. Perring, C. E.'

'We hereby certify, that we examined the place whence the iron in question was taken by Mr. Hill, and we are of the opinion, that the iron must have been left in the joint during the building of the Pyramid, and that it could not have been inserted afterwards.—Ed. S. Andrews,—James Mash, C. E.'[1]

Despite the above testimonials, because the chronology for the development of metals did not include wrought iron in the age of the pyramids, the specialists at the British Museum concluded that this wrought-iron artifact could not be genuine and must have been introduced in modern times. Nevertheless, after examining the piece in 1881, Petrie objectively noted:

That sheet iron was employed we know, from the fragment found by Howard Vyse in the masonry of the south air channel; and though some doubt has been thrown on the piece merely from its rarity, yet the vouchers for it are very precise; and it has a cast of nummulite on the rust of it, proving it to have been buried for ages beside a block of nummulitic limestone, and therefore to be certainly ancient. No reasonable doubt can therefore exist about its being a really genuine piece used by the pyramid masons; and probably such pieces were required to prevent crowbars biting into the stones, and to ease the action of the rollers.[2]

Because of the British Museum's proclamation, and despite Petrie's opinion, this metal plate received little attention until very recently when

Robert Bauval and Graham Hancock doggedly researched its history. They reported that "Despite this forceful opinion from one of the oddball giants [Petrie] of Egyptology in the late Victorian Age, the profession as a whole has been unable to cope with the idea of a piece of wrought iron being contemporary with the Great Pyramid. Such a notion goes completely against the grain of every preconception that Egyptologists internalize throughout their careers concerning the ways in which civilizations evolve and develop."[3]

Hancock and Bauval go on to say that in 1989, after rigorous testing of a fragment cut from the plate, two eminent metallurgists, Dr. M. P. Jones, senior tutor in the Mineral Resources Engineering Department at Imperial College, London, and Dr. Sayed El Gayer, who gained his Ph.D. in extraction metallurgy at the University of Aston in Birmingham, reported that "it is concluded, on the basis of the present investigation, that the iron plate is very ancient. Furthermore, the metallurgical evidence supports the archaeological evidence which suggests that the plate was incorporated within the Pyramid at the time that structure was being built."[4]

Jones and El Gayer determined that the plate was not of meteoric origin and that it must have been smelted at between 1,000 and 1,100 degrees centigrade. They also discovered the presence of gold on one surface of the plate during these tests.

Armed with this expert data—and 110 years after Petrie's objective analysis—Hancock and Bauval spoke with Dr. A. J. Spencer and Dr. Paul Craddock of the British Museum, who characterized Jones' and El Gayer's conclusions as being "highly dubious," though they would not comment further to support this statement.

Having worked with metallurgists and technologists, and having read the works of and seen the documentaries of Egyptologists, when I compare these two conflicting opinions I place more trust in the science and objectivity of the metallurgists. Egyptologists have a vested interest in continuing their teachings as they have taught them for the past century. To do otherwise would be to admit that they have been wrong. The iron plate is just a small, though significant, item in a large collection of anomalies that have been ignored or misinterpreted by many academics because they contradict their

orthodox beliefs.

ENDNOTES

INTRODUCTION

1. Peter Tompkins, *Secrets of the Great Pyramid, 382.*

2. William Fix, *Pyramid Odyssey,* 219.

CHAPTER ONE

1. Richard Hoagland at www.enterprisemission.com

2. Peter Tompkins, *Secrets of the Great Pyramid,* 218.

3. *Encyclopedia Britannica,* 15th ed., s.v. "Hegira."

4. Graham Hancock and Robert Bauval. *The Message of the Sphinx,* 101–103.

5. William Fix, *Pyramid Odyssey,* 65. The statement was made at the time Dr. Lehner was being funded by the Edgar Cayce foundation for his research in Egypt.

6. See Erich von Daniken, *Chariot of the Gods.*

7. Hancock, Bauval, and West are major proponents of the theory that the Sphinx was constructed during the age of Leo, over 10,000 years ago. West and geologist Robert Schoch claim that the weathering of the Sphinx and of the surrounding limestone wall is the result of repeated heavy rainfall, which has not occurred in Egypt for over 10,000 years.

8. Both Smyth quotations are from *The Great Pyramid: Its Secrets and Mysteries Revealed,* 132.

9. This is an estimate provided by Merle Booker, director of the Indiana Limestone Institute, to Richard Noone, author of *5/5/2000 Ice: The Ultimate Disaster.* Booker estimated that it would require that the entire Indiana limestone industry, comprised of thirty-three quarries, triple its current output, and the estimate did not allow for equipment breakdowns

or labor problems.

10. Fix, *Pyramid Odyssey*, 66.

11. Ibid.

12. Kurt Mendelssohn, *The Riddle of the Pyramids*, 75.

13. I.E.S. Edwards, *Ancient Egypt: Discovering Its Splendors*, 84.

14. These two quotations are from *Ancient Egypt*, 88.

15. From an interview with the *Sunday Telegraph* (London), January 1, 1995.

16. See Petrie's *Pyramids and Temples of Gizeh.*

17. Peter Lemesurier, *The Great Pyramid Decoded*, 174–175.

18. Mark Lehner, *The Complete Pyramids*, 111.

19. Lehner's *The Complete Pyramid is* a marvelously executed graphic exploration of the pyramids of Egypt. To completely analyze each of the remarkably complex and mechanical designs found within each of these pyramids would require the same attention to each one as was given to the Great Pyramid for the past century and more.

20. Tompkins, 251. Architect James Hagan also agrees with these observations.

CHAPTER TWO

1. Peter Tompkins, *Secrets of the Great Pyramid*, 21.

2. The information regarding Greaves, Davison, Caviglia, and Davidson is recounted in Tompkins.

3. William Flinders Petrie, *Pyramids and Temples of Gizeh*, 19.

4. Tompkins, 249.

5. Ibid.

6. I.E.S. Edwards, *The Pyramids of Egypt*, 290-291.

7. Petrie, *Pyramids and Temples*, 86.

8. Ibid, 19.

9. Ibid, 26.

10. Edwards, *The Pyramids of Egypt*, 106.

11. Piazzi Smyth, *Our Inheritence in the Great Pyramid*, 174–175.

12. Ibid, 175–176.

13. Ibid, 174.

14. Petrie, *Pyramids and Temples*, 27.

15. Ibid.

16. Ibid.

17. Ibid, 28.

CHAPTER THREE

1. In manufacturing, "tolerance" is a unit of measure within which a deviation from a perfect form can be tolerated.

2. William F. Petrie, *Pyramids and Temples of Gizeh,* 13. Petrie's reference to the work of opticians has been taken out of context by modern writers. The accuracy required of some optical components is measurable to less than a wavelength of light.

3. Mark Lehner, *The Complete Pyramids*, 208-209.

4. Atlantis Rising Video, *Technologies of the Gods,* 1998. Hagan quotes are from this source and personal conversations.

5. Richard Noone, *5/5/2000 Ice: The Ultimate Disaster*, 105.

6. Petrie, *Pyramids and Temples*, 77.

7. Ibid, 13.

8. Max Toth, *Pyramid Prophecies*, 81.

9. I.E.S. Edwards, *Ancient Egypt,* 89.

10. Lehner, 209.

11. Netherlands Television, *Genesis in Stone*, 1995.

CHAPTER FOUR

1. I.E.S. Edwards, *Ancient Egypt,* 91.

2. William Flinders Petrie, *Pyramids and Temples of Gizeh,* 29.

3. Ibid, 35.

4. Ibid, 29.

5. Ibid.

6. Ibid, 77.

7. Ibid,78.

8. Ibid, 75, 76, 78.

9. A. Lucas, *Ancient Egyptian Materials and Industries,* 88.

10. *Encyclopedia Britannica,* 15th ed., S.v. "Ultrasonics and Infrasonics."

CHAPTER FIVE

1. William Flinders Petrie, *Pyramids and Temples of Gizeh,* 35, 36.

2. I.E.S. Edwards, *The Pyramids of Egypt,* 134.

3. Petrie, *Pyramids and Temples,* xii.

4. Joseph Davidovits and Margie Morris, *The Pyramids: An Enigma Solved,* 85–86.

CHAPTER SIX

1. Information on Coral Castle can be obtained from Coral Castle, 28655 S. Dixie Highway, Homestead, FL 33030 USA. Tel: 305-248-6344. For a nominal charge, the proprietors will mail a package that includes Leedskalnin's papers on electricity and magnetism and a small self-published book entitled *A Book In Every Home,* in which Leedskalnin instructs the reader on how to raise a young lady. Is this a metaphor? I don't know; it is a strange little book and I have not quite figured it out yet.

CHAPTER EIGHT

1. *Encyclopedia Britannica,* 15th ed., s.v. "Sound, Sources of:"

2. From the archive of "Dr. Magneto's Questions and Answers" at http://image.gsfc.nasa.gov/~odenwald/asklq768.html. Other references on Earth's resonance can be found on the Internet by doing a search for "schumann resonance."

3. Quoted in Peter Tompkins, *Secrets of the Great Pyramid,* 72. Further

Taylor quotes from the same source.

4. Ibid, 74.

5. Piazzi Smyth, *The Great Pyramid: Its Secrets and Mysteries Revealed*, 285.

6. Ibid, 287.

7. William Flinders Petrie, *Pyramids and Temples of Gizeh*, 13.

8. William Fix, *Pyramid Odyssey*, 232.

9. *Encyclopedia Britannica*, 15th ed., s.v. "Vibration."

10. Said may have meant "four *resonant* frequencies."

11. Quoted from Said's website at http://www.lauralee.com/said.htm (October 1997).

12. Paul Horn, *Inside the Great Pyramid*, Mushroom Records, 1977.

13. Tompkins, 279.

14. Bill Kerrel and Kathy Goggin, *The Guide to Pyramid Energy*, 14.

15. Bill Schul and Ed Pettit, *The Secret Power of Pyramids*, 105.

16. Dale Pond and Walter Baumgartner, *Nikola Tesla's Earthquake Machine*, 5–6.

17. Thomas Bearden, *Establishing a Standing Scalar EM Wave in the Earth*, 6–47.

18. Ibid, 6–45.

CHAPTER NINE

1. Dee Jay Nelson and David H. Coville, *Life Force in the Great Pyramids*, 73.

2. William Flinders Petrie, *Pyramids and Temples of Gizeh*, 28.

3. Ibid, 30.

4. Piazzi Smyth, *The Great Pyramid: Its Secrets and Mysteries Revealed*, 7.

5. Petrie, *Pyramids and Temples*, 31.

6. Paul Horn, *Inside the Great Pyramid*, Mushroom Records, 1977.

7. Ibid.

8. Petrie, *Pyramids and Temples,* 30.

9. Smyth, 447–448, 451, 452.

10. Ibid, 452.

11. Petrie, *Pyramids and Temples,* 8.

12. *Encyclopedia Britannica,* 15th ed., s.v. "Vibrations: Energy and Power in Vibrations."

13. Graham Hancock, *Fingerprints of the Gods,* 333.

14. Ibid.

15. Petrie, *Pyramids and Temples,* 21.

CHAPTER TEN

1. *Encyclopedia Britannica,* 15th ed., s.v. "Radio Sources, Astronomical."

2. Ibid, s.v. "Lasers and Masers."

3. Ibid, s.v. "Masers."

4. Piazzi Smyth, *The Great Pyramid: Its Secrets and Mysteries Revealed,* 416.

5. Ibid.

6. Ibid, 156.

CHAPTER ELEVEN

1. *Encyclopedia Britannica,* 15th ed., s.v. "Catalysis."

2. Graham Hancock and Robert Bauval, *Message of the Sphinx,* 115–116.

3. Richard Noone, *5/5/2000: Ice: The Ultimate Disaster, 99.*

4. Report prepared for me by chemical engineer Joseph Drejewski.

5. Hancock and Bauval, *Message of the Sphinx,* 51.

CHAPTER TWELVE

1. William Flinders Petrie, *Pyramids and Temples of Gizeh,* 87.

2. Peter Tompkins, *Secrets of the Great Pyramid,* 249.

CHAPTER THIRTEEN

1. Peter Tompkins, *Secrets of the Great Pyramid*, 107.

CHAPTER FOURTEEN

1. Nikola Tesla, *The Fantastic Inventions of Nikola Tesla*, 219–240.
2. Brad Steiger, *Worlds Before Our Own*, 74–75.
3. Ibid, 7–76.
4. Robert Bauval and Adrian Gilbert, *The Orion Mystery*, 73–74.
5. Ibid, 90–91.
6. Edgar Evans Cayce, *Edgar Cayce on Atlantis*, 88–90.
7. *The New Webster Encyclopedic Dictionary of the English Language*, 1973, s.v., "igneous."
8. Cayce, *Edgar Cayce on Atlantis*, 85.

CHAPTER FIFTEEN

1. Brad Steiger, *Worlds Before Our Own*, 16.
2. David Wilson, *The New Archaeology*, 97.
3. Willard Frank Libby Ph.D. received the 1960 Nobel Prize for chemistry for his work on radioactive carbon dating.
4. Wilson, 112.
5. J.A.B. van Buitenen, *The Mahābhārata*, xxv-xxxvii.
6. Ibid, 75–76.
7. Ibid, 88.
8. Ibid, 89.
9. Ibid, 419.
10. Chakravarthi V. Narasimhan, *The Mahābhārata*, 117–118.
11. Ibid, 166.
12. Andrew Tomas, *We Are Not the First*, 75.
13. Ibid.

14. Quoted in Louis Pauwels and Jacques Bergier, *The Morning of the Magicians*, 181.

15. Tomas, *We Are Not the First*, 76.

16. Pauwels and Bergier, *The Morning of the Magicians*, 170–171.

APPENDIX B

1. Quoted in Max Toth, *Pyramid Prophecies*, 208-209.

2. William Flinders Petrie, *Pyramids and Temples of Gizeh*, 85.

3. Graham Hancock and Robert Bauval, *The Message of the Sphinx*, 106.

4. Ibid, 106-107.

BIBLIOGRAPHY

Bauval, Robert, and Adrian Gilbert. *The Orion Mystery: Unlocking the Secrets of the Pyramids.* New York: Crown, 1994.

Bearden, Thomas. "Maxwell's Lost Unified Field Theory." In *Proceedings of the International Tesla Symposium.* Edited by Steven R. Elswick, section 6, 24–68. Colorado Springs, CO: International Tesla Society, 1988.

Cayce, Edgar Evans. *Edgar Cayce on Atlantis.* New York: Warner Books, 1968.

Davidovits, Joseph, and Margie Morris. *The Pyramids: An Enigma Solved.* New York: Hippocrene Books, 1988.

Edwards, I.E.S. "Pyramids: Building for Eternity." In *Ancient Egypt: Discovering Its Splendors.* Edited by Gilbert M. Grosvenor, 73–101. Washington, D.C.: National Geographic Society,1978.

_____. *The Pyramids of Egypt.* London: Penguin Books, 1993.

Evans, Humphrey. *The Mystery of the Pyramids.* New York: Thomas Y. Crowell, 1979.

Fix, William. *Pyramid Odyssey.* New York: Mayflower Books, 1978.

Hancock, Graham. *Fingerprints of the Gods.* New York: Crown, 1995.

Hancock, Graham, and Robert Bauval. *The Message of the Sphinx.* New York: Crown, 1996.

Hodges, Henry. *Technology in the Ancient World.* New York: Barnes and Noble, 1992.

Horn, Paul. "Paul Horn—Inside the Great Pyramid." Booklet included in LP record of the same name. Los Angeles: Mushroom Records, 1977.

Kerrel, Bill, and Kathy Goggin. *The Guide to Pyramid Energy.* Santa Monica, CA: Pyramid Power -V, 1975.

Knudsen, Vern O. "Architectural Acoustics." In *Scientific American: The*

Physics of Music. San Francisco: W.H. Freeman and Company, 1963.

Leedskalnin, Edward. *A Book in Every Home.* Homestead, FL: Edward Leedskalnin, 1936.

_____. *Magnetic Current.* Homestead, FL: Edward Leedskalnin, 1945.

Lehner, Mark. *The Complete Pyramids: Solving the Ancient Mysteries.* London: Thames & Hudson, 1997.

Lemesurier, Peter. *The Great Pyramid Decoded.* New York: Avon Books, 1979.

Lucas, A. *Ancient Egyptian Materials and Industries.* London: Histories and Mysteries of Man, 1989.

The Mahābhārata: 1. *The Book of the Beginning.* Translated and edited by J.A.B van Buitenen. Chicago: University of Chicago Press, 1983.

The Mahābhārata. Translated by Chakravarthi V. Narasimhan. New York: Columbia University Press, 1965.

Mendelssohn, Kurt. *The Riddle of the Pyramids.* New York: Praeger, 1974.

Nelson, Dee Jay, and David Coville. *Life Force in the Great Pyramid.* Marina del Rey, CA: DeVorss & Company, 1977.

Noone, Richard. *5/5/2000 Ice: The Ultimate Disaster.* New York: Harmony Books, 1986.

Pauwels, Louis, and Jacques Bergier. *The Morning of the Magicians.* New York: Avon, 1968.

Petrie, William Flinders. *Pyramids and Temples of Gizeh.* 1883. Reprint, with an update by Dr. Zahi Hawass, London: Histories and Mysteries of Man, 1990.

_____. *Ten Years Digging in Egypt.* 1891. Reprint, Chicago: Ares Publishers, 1989.

Pond, Dale, and Walter Baumgartner. *Nikola Tesla's Earthquake Machine.* Santa Fe, NM: The Message Company, 1995.

Schul, Bill, and Ed Pettit. *The Secret Power of Pyramids.* Greenwich, CT: Fawcett Publications, 1975.

Smyth, Piazzi. *The Great Pyramid: Its Secrets and Mysteries Revealed.* 4th.

ed. New York: Bell Publishing Company, 1978. Originally published as *Our Inheritance in the Great Pyramid.* London: W. Isbister, 1880.

Sprague de Camp, Lyon. *The Ancient Engineers.* New York: Ballentine Books, 1974.

Steiger, Brad. *Worlds Before Our Own.* New York: Berkley Publishing, 1978.

Technologies of the Gods. Produced and directed by J. Douglas Kenyon and N. Thomas Miller. 65 min. Atlantis Rising Video, 1998. Videocassette.

Tesla, Nikola, and David Hatcher Childress. *The Fantastic Inventions of Nikola Tesla.* Kempton, IL: Adventures Unlimited, 1993.

Tomas, Andrew. *We Are Not the First: Riddles of Ancient Science.* London: Souvenir Press, 1971.

Tompkins, Peter. *Secrets of the Great Pyramid.* New York: Harper & Row, 1971.

Wilson, Colin. *From Atlantis to the Sphinx.* London: Virgin Books, 1996.

Wilson, David. *The New Archaeology.* New York: Alfred A. Knopf, 1975.

The World's Last Mysteries. New York: Reader's Digest Association, 1978.

ABOUT THE AUTHOR

Christopher Dunn has an extensive background as a master craftsman, starting as a journeyman lathe turner in his home town of Manchester, England. Recruited by an American aerospace company, he immigrated to the United States in 1969. Beginning as a skilled machinist, he has worked at every level of high-tech manufacturing from toolmaking to operating high-power industrial lasers, including the position of Project Engineer and Laser Operations Manager at DMS, a Midwest aerospace manufacturer.

The author's pyramid odyssey began in 1977 when he read Peter Tompkins' book *Secrets of the Great Pyramid.* His immediate reaction to the Giza Pyramid's schematics was that this edifice was a gigantic machine. Discovering the purpose of this machine and documenting his case has taken the better part of twenty years of research. In the process he has published a dozen magazine articles, including the much quoted *Advanced Machining in Ancient Egypt* in *Analog,* and has had his research referenced in such books as Graham Hancock's *Fingerprints of the Gods* and Colin Wilson's *From Atlantis to the Sphinx.* Chris Dunn, his wife Jeanne, and their children live in Danville, Illinois.

Christopher Dunn is featured in the Mystic Fire video *Technologies of the Gods: The Case for Pre-Historic High Technology,* which brings together convincing evidence that ancient civilizations utilized high-tech engineering methods equal to if not superior to our own and that these technologies were being applied on a worldwide level. This case is presented by such renowned experts as Robert Bauval, Richard Noone, Colin Wilson, John Michell, Patrick Flanagan, Zecharia Sitchin, David Hatcher Childress, Edgar Evans Cayce, as well as Christopher Dunn. You can order *Technologies of the Gods* by writing Mystic Fire Video, P.O. Box 422, Prince Street Station, New

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